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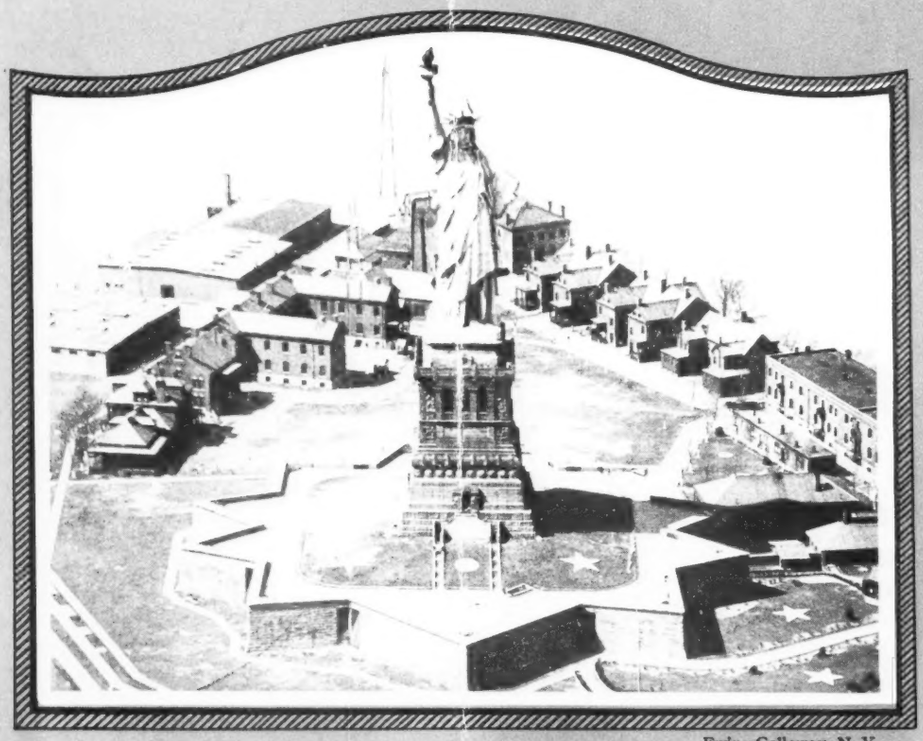

Ewing Galloway, N. Y.

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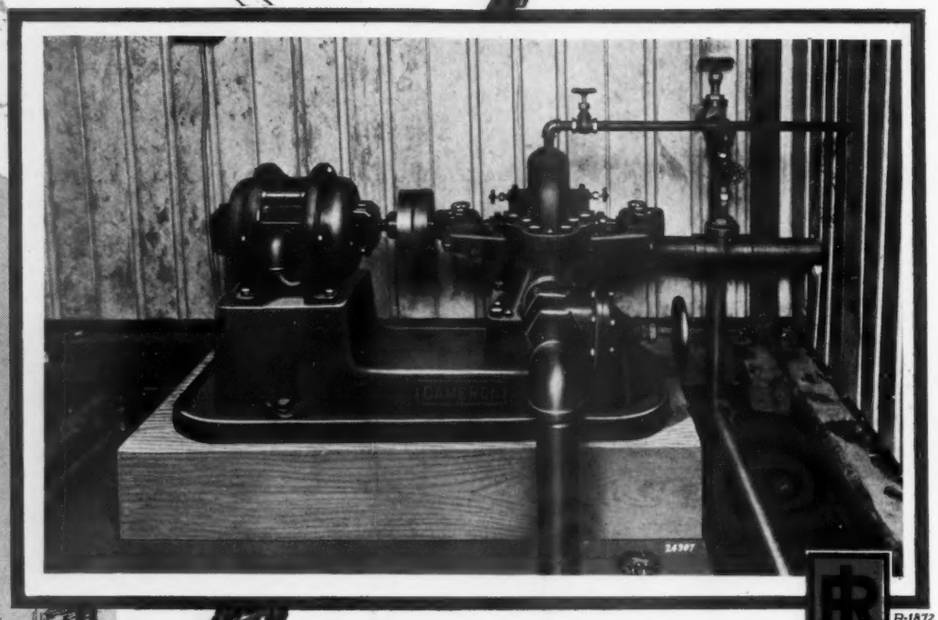

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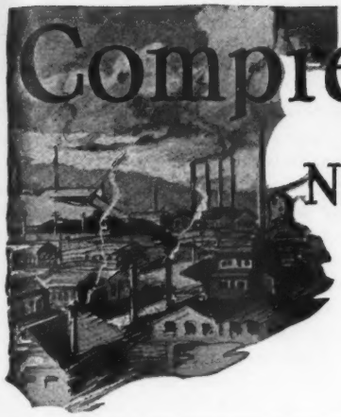

Compressed Air Magazine

NEW YORK · LONDON · PARIS

Principal Offices
Bowling Green Building
No. 11 Broadway
New York.

VOL. XXXIV, No. VIII

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Compressed Air Magazine Co.
AUGUST, 1929

Bonanza Days of the Mining West

Falling Tides of Fortune Have Left Their Mark on Erstwhile Famous Gold and Silver Camps

By C. H. VIVIAN

WHEN Cripple Creek, Colo., was in its first flush of gold excitement, and there had not yet been time to construct any of the three railroads that eventually served it, heavily laden ore wagons, drawn by from four to eight mules, moved in almost endless procession to the Town of Divide, on the Colorado Midland Railway. Some ten miles out of Cripple Creek, where the roadway skirted the base of Pike's Peak, a rock protruded from the ground in one of the furrows that the wheels had worn. There were rocks aplenty throughout the course of the crude highway, but only this particular one concerns this narrative.

One day a driver, who hadn't mastered the fine points that go to make up the now almost extinct art of mule-skinning, reached back and secured from his load a choice specimen of calaverite, which he let fly at one of the lead mules with perfect aim. The mule gave a jump that added impetus to the wagon just as the left front wheel came against the jutting rock. The resulting jolt jostled a 50-pound chunk of ore off the load, and it rolled down the gentle slope for nearly 150 feet before coming to rest at the entrance to a badger hole. It so happened that the gold-bearing missile which had been cast at the mule ricocheted off the animal's back and took a course that deposited it on the same side of the road as the larger piece of ore and less than 200 feet away from it.

Several months passed. The deep snows of winter descended, and in the spring they melted and formed rivulets that carried sediment. The sediment filled up the badger hole and piled up around the large piece of calaverite so that only its top was exposed. The smaller specimen was also partially buried where it lay among the young shoots of grass that were just breaking forth under a friendly sun.

During the following summer a prospector roamed over the region. He knew little of gold ore or of its mode of occurrence, for until a few weeks previously he had been leading the prosaic life of minister of the gospel in a Minnesota town. Like thousands of others he had read of the fortunes that were being dug from the ground "out West", and had forsaken the cloth for a more adventurous existence and one that held forth a promise of greater monetary rewards. In Cripple Creek he had seen enough calaverite to acquaint him with its general appearance; and he had taken to the hills to search for it. Learning that the area within a 5-mile radius of Cripple Creek had been gone over as though with a fine-tooth comb, he drifted farther afield.

Denver Tourist Bureau

A figure out of the past. Panning for gold on Clear Creek, west of Denver.

Chance led him to the spot where the larger piece of ore lay, and he fell frantically to work digging it out. Beneath it and on all sides of it he found only the light-brown granular earth that is formed by the disintegration of granite, and there was no sign of mineralization. He had heard the miners in Cripple Creek speak of float rock, and he concluded that such was his find. Somewhere nearby, he reasoned, was the mother lode from which this boulder had broken. But if one piece had become detached from the vein, so must others. Accordingly, he renewed his quest for supporting evidence of a proximate bonanza. Diligent search brought discovery of the small piece of ore that had bounded from the lead mule's back. Then the minister was sure that he was hot on the trail of a treasure trove.

For several days he traveled a continually widening circle, probing here and there with his pick, but without success. It became evident to him that he must delve below the surface, that he must remove the mantle of soil that was hiding the vein from view. That called for money to hire men and to buy simple machinery. His supply of funds was

meager, so rather than appeal to comparative strangers in Cripple Creek and thereby probably precipitate a rush that might deprive him of his prize, he wrote to members of his congregation in Minnesota and implored their financial assistance, in return for which he promised a substantial interest in the profits which he felt confident would accrue. The good churchmen in the Minnesota town not only sent money but many of them delivered it in person and sought a hand in unearthing the supposed vein of gold ore.

As a result, windlasses and buckets were procured, and pick-and-shovel brigades began perforating the earth's crust. The operations attracted attention, and word of a new "find" soon spread like wildfire through Cripple Creek and other camps of the state. Hundreds of hopeful prospectors hotfooted it to the scene of activity and raced one another in staking out claims. More picks, shovels, and windlasses appeared, and soon an army of workers was tearing up the landscape.

Because those who dug had to eat, sleep, and be diverted from their labors, there came more men to set up stores and houses and amusement places. Almost overnight a town came into being—the Town of Gillette, and every day it grew on its momentum, like a snowball rolling down hill. Real-estate men appeared on the scene and began selling lots. Streets were laid out, and a water system sufficient to serve 30,000 persons was installed. Meanwhile, all the frantic digging produced nothing but a lot of holes in the ground and mounds of brown earth beside them. Gradually it dawned upon the populace that Gillette was not destined to become a second Cripple Creek, and they began to move on to investigate other "finds". In a few months the town was deserted.

In after years most of the buildings were torn down by salvagers, and the others rotted and collapsed. Today the automobile road between Colorado Springs and Cripple Creek passes within a quarter-mile of the site where stands a signpost on which is inscribed "Gillette" and bearing a hand that points toward the base of Pike's Peak. If you take the trouble to follow the course it marks, you will come upon a fire plug here and there in the tall grass and numerous mounds of dirt each with a caved-in excavation beside it. One heap is larger than the others. It is the one that was built by the minister who failed to find gold but who, so the story goes, made his "pile" from the funds that were eagerly supplied by the members of his erstwhile flock in Minnesota.

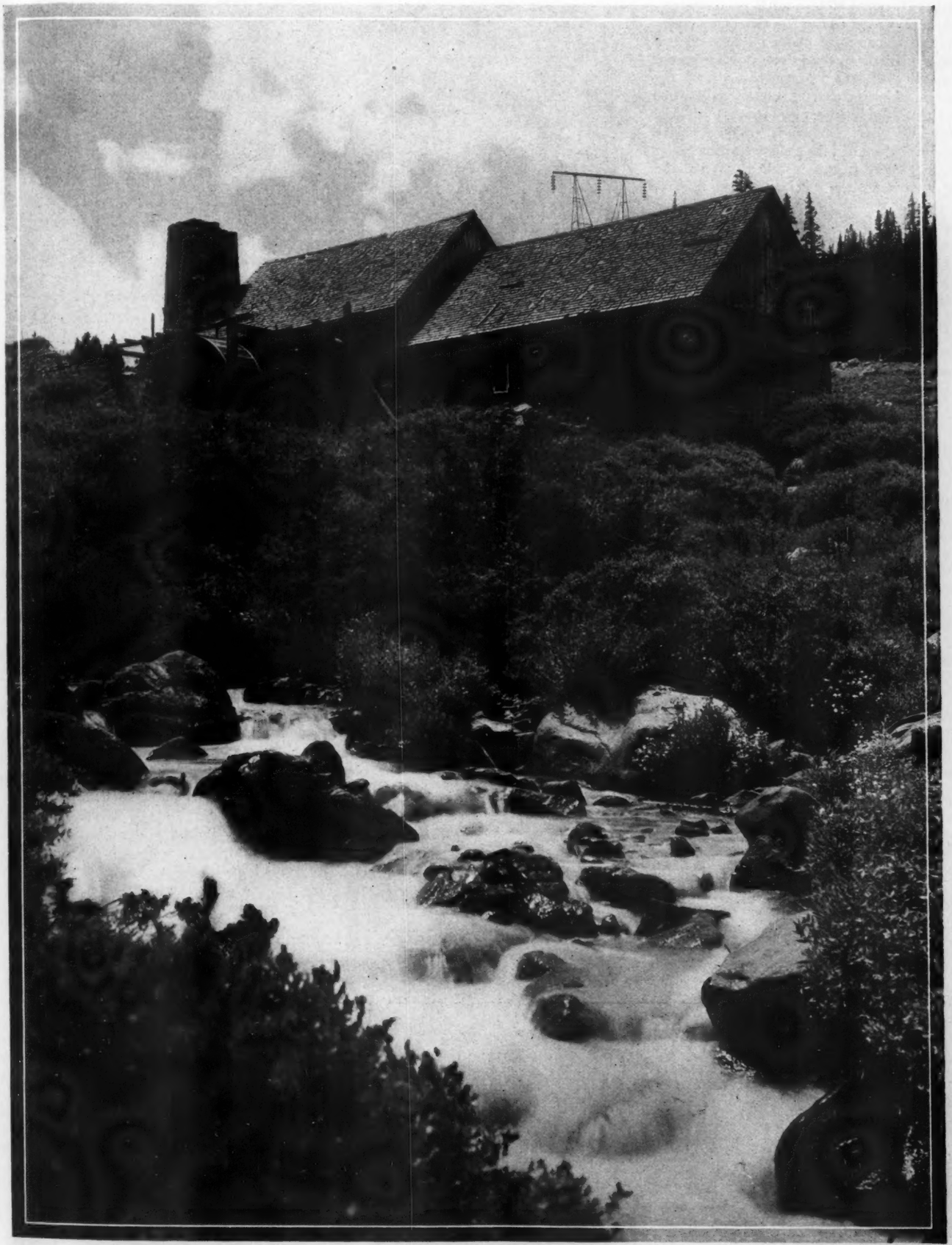
The West contains many of these "ghost" camps. Some, like Gillette, "died aborning". There was no ore there to give them the breath of life. Most of them, however, have known days of opulence—boom days during which they gave the world vast sums in gold and silver and made men wealthy almost overnight. Life coursed through their now silent streets. Some have been forsaken by human beings and only their toppling skeletons remain. Others, though they have heard the *requiem* of their mining activities, are still peopled by a few of the old guard who hold to their homes because they have no other place to go. Still others are facing municipal death, but are hanging on fighting the inevitable. In these camps the ore comes from the ground in driblets now, but each driblet is an extension of the lease on life. At the same time, it is bringing their doom that much nearer. They may be likened to a castaway upon a barren island who munches each bite of his food knowing full well that it hastens the time when he will die of starvation.

Cripple Creek, once a name to conjure with, presents a shrunken appearance compared to that of 30 years ago. One by one its mines have shut down until there are now but a few in operation. Victor, Independence, Altman, and a score of lesser communities that made up the famed Cripple Creek District, are more or less on their uppers. Slowly but surely they are traveling toward that inescapable graveyard that eventually claims the gold camps. A dozen years, two dozen, perhaps more—for a gold camp dies hard, and they will pass into oblivion.

During the World War, when building materials commanded a high price, more than 1,000 structures were razed in Cripple Creek and parts of them shipped away to be sold. One of the buildings thus torn up by the roots

Denver Tourist Bureau

Cripple Creek, about 1900, at the height of its boom. More than 1,000 of the buildings in this picture were dismantled and the salable materials shipped out for use elsewhere during the war period.



Denver Tourist Bureau

An early-day smelter. This structure was built of hewn logs and its machinery operated by power from the water wheel at the left. Just beyond the building is the top of a modern steel tower that carries high-tension power lines past this relic of a former era of activity.

was the National Hotel, a 200-room hostelry that once was crowded to the doors every night. The names of many millionaires had graced its register. Because it was erected on a hill that sloped abruptly up from the street on which it fronted, as much as $70,000 was spent merely to excavate its foundation. Today, all that remains is that expensive hole in the ground, with a rusty heating boiler standing where it was installed. When the lean days came, the National failed to pay, and became a white elephant on its owner's hands. The man who dismantled it for the salvage of its materials paid $10,000 for it.

Taxes are a bugbear in a declining mining camp. As the towns grew up, water, lights, sewage systems, and other improvements were provided and bonds issued to defray their cost. No one felt the taxes during the boom days; but, as the camps dwindled, the valuation decreased to the point where an almost prohibitive levy was necessary to meet sinking-fund provisions. The total tax rate in many of these camps at the present time is more than 8 per cent, and in some it is more than 12 per cent. The municipalities own most of the property—the original owners having simply moved away and left whatever they had. There is generally but a limited market for the real estate, and that is created by persons who desire a place where they can spend a summer vacation in the coolness of the mountains. Many of the deserted homes are partially furnished—just as they were left by owners who intended to return, but never did. It is possible to buy a commodious house in some of these western mining towns today for from $200 to $500.

As many of the earlier camps were volatile affairs, prospectors and miners came to view all cities with a suspicion of instability. Upon this mental attitude is based the classic story of the prospector who returned from a visit to New York with the comment that "it looks like a permanent camp".

Where Leadville was born. California Gulch, which yielded $10,000,000 in placer gold in its heyday. Dump of a deserted mine at right.

Panamint, on the western side of Death Valley, 70 miles south of Bullfrog, Nev., was a roaring town back in the "seventies". It was rich in silver ore in those days; but the veins proved to be only shallow "pipes" that soon gave out, and then there was nothing to keep the town alive. Time and the elements have reduced its collection of tumbled-down structures to a mere semblance of their former selves. The smelter that was built to refine the silver still stands. The population of Panamint consists of two men, Chris Wicks and James Madden. They settled there years after the mining excitement had passed.

Leadville, Colo., had 40,000 inhabitants in 1880 when the rush that followed the discovery of silver-bearing carbonates was at its peak. It constructed homes and business buildings to accommodate that number of persons; but in a few years it had contracted to one-fourth that figure. Today, as a producer of lead and zinc and small amounts of other metals, Leadville has a population of approximately 4,000. Block after block of dilapidated houses have not been occupied for years; and along Harrison Avenue, the principal business street, few of the stores are in use.

Seven weather-beaten shacks, a lone resident who seldom sees anyone from the outside world, and rimming hillsides dotted with ore dumps and wasting mine buildings mark the spot where the bustling camp of Montgomery, Colo., once vibrated. It had 6,000 people when word came of a great strike at Leadville, a few miles away. Because what little ore had been found at Montgomery was of low grade and the claims were held in a few hands, there was a general exodus for the new Eldorado. In any event, within a few years the veins were found to be of little value, and the camp was practically deserted.

Leonard Nichols is the sole remaining resident of Nevadaville, Colo., a few miles across the mountains from Idaho Springs, where the initial Rocky Mountain gold discovery was made in 1859. In its heyday, Nevadaville was a thriving camp and numbered among its citizens some who afterwards attained prominence. One of them was the late Thomas F. Walsh, father-in-law of Edward B. McLean, the Washington publisher. Walsh became a millionaire at Ouray, Colo., where he developed the Camp Bird gold mine which he sold to a British syndicate for $5,300,000 in 1902. Walsh subsequently served as United States Senator from Colorado. Although well-nigh deserted, Nevadaville is certain of at least one visitation each year. One of the first Masonic lodges of the state was formed there and still holds one meeting a year in the derelict camp to retain its charter.

The World War, which reduced many gold camps to privation because production costs rose sharply while the price received for gold remained fixed at $20.67 an ounce, was also responsible for the birth of many short-lived mining communities. Such a one was Nederland, Colo., which almost overnight developed into a city of 5,000 persons by virtue of the tungsten deposits in the surrounding hills. Tungsten became an indispensable element in the making of alloy-steel cutting tools used in the manufacture of munitions; and its price mounted fifteenfold within a few months. The armistice dealt almost a death blow to the industry; and the town is now reduced to 300 inhabitants. Millions of dollars worth of mining and milling machinery stopped turning its wheels when the firing ceased overseas. The Government reimbursed many of the

Denver Tourist Bureau

Tumble-down buildings in Black Hawk, Colo., where the first quartz mines of the state were discovered in 1859. Black Hawk and the adjoining camp of Central City were called "The Cradle of Colorado."

Denver Tourist Bureau

Camp Bird Mine at Ouray, Colo., from which the late Thomas F. Walsh took a fortune.

producers under the provisions of the War Industries Act, as they had been urged to mine the mineral as a patriotic measure. With the war over and the demand for tungsten greatly reduced, foreign production became a market factor. A small protective tariff was placed on tungsten; but, even with its help, few of the deposits were rich enough to be profitably worked in the face of competition with cheap labor in China. During the boom, lots in Nederland sold as high as $2,000 each. Persons who bought them and erected business buildings were suddenly left without tenants when depopulation came.

In 1908, Goldfield, Nev., numbered 32,000 persons, and six years later it had but 3,500. The decline of Goldfield was hastened by a disastrous fire. The town was partly rebuilt, but was visited by a second devastating conflagration a few years ago.

Thousands of miles of railroad were constructed in the mountains of the West to serve the metal-producing areas. The work involved was expensive, and the steepness of the grades made operations costly. As soon as ore shipments fell off to the point where the lines no longer paid, abandonment became an economic necessity, and the rails were pulled up. Cripple Creek is today served by but one of the three lines that formerly ran there, and that remains only because the Carlton Brothers, who own most of the operating mines, bought it to save it from being dismantled. This road, the Colorado Midland, was the first to reach the camp; and it enjoyed such a volume of business that the receipts during the first year are said to have paid the cost of construction. The last to reach the town, the Cripple Creek Short Line, was sold for junk a few years ago to W. D. Corley of Colorado Springs. He removed the rails and ties and converted the right of way into a toll automobile road for tourists. The scenery along its route is such that the railway formerly used as its slogan, "The Trip That Bankrupts the English Language".

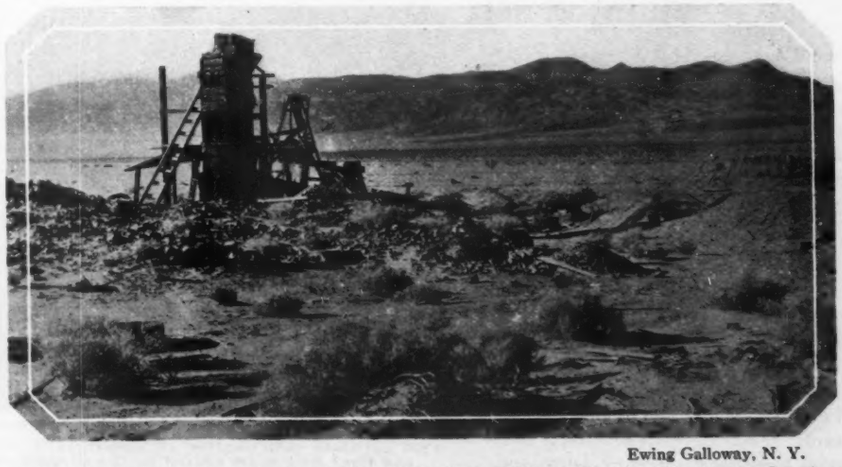
Within recent years Marysville, Mont., was erased from the railroad map. In 1900 it had 7,500 residents and was the goal of a race between the Northern Pacific and the Great Northern railroads. The Marysville district is credited with a gold production of more than $100,000,000. Two-thirds of the ore came from the Drumm Lummon Mine, which is still being worked on a restricted basis by a handful of men.

Rhyolite and Tonopah, Nev., are but skeletons of their former selves, the first-named being practically deserted. Many of the camps established by the forty-niners in California have passed into oblivion. Throughout the Rocky Mountain and Pacific Coast expanse are scores of these ghost towns. Their history has much in common. The initial strike brought hordes of wealth seekers and the usual quota of adventurers, gamblers, and camp followers. Either the mineral was not present in sufficient quantities to support more than a fraction of the population or, with increasing depth, with the encountering of water or any of a long list of other eventualities, the cost of taking the ore from the ground became greater than its value.

In the placer camps, Chinese are the final inhabitants. Patient, industrious, and demanding little on which to live, they take over the gravel deposits when the white man forsakes them and manage to eke out an existence for many years. Every western camp abounded with Celestials in its boom days. They served as camp launderers while they waited for the Anglo-Saxon to shoulder his belongings and to pass on to other fields.

It is interesting to note that the richer a camp the more inevitably it was doomed to desertion. Its richness attracted far more people than it could support; and, in its first wave of enthusiasm, the camp built for all comers. This created overbuilding, for a large percentage stayed only until tidings reached them of another strike elsewhere. With the richness of the veins proved, eagerness for the metal became the ruling passion, and mining was pushed with all possible speed. Thus, often, the cream would be skimmed from the top within a few years, leaving the camp on the down grade.

By way of contrast, it is equally interesting to observe that the low-grade property frequently produces more mineral in the long run and, by virtue of its greater deposits and more businesslike methods of ore recovery and treatment, remains a potent factor in the mining world after many of the picture-rock-at-grass-roots bonanzas are forgotten. In general, such camps do not experience the hectic boom periods that attend the high-grade ore camps. Today, when the names of Cripple Creek and Goldfield have lost much of their magic, Lead, S. D., goes on with undiminished vigor. At Lead, the Homestake Mine produces about 3,900 tons of ore a day. Though this averages less than $5 a ton, the Homestake pays a higher dividend than most lines of business and is annually adding materially to a production record that now exceeds $200,000,000.



Ewing Galloway, N. Y.

Story without words. Ruin of a Death Valley, Calif., gold mine that turned out to be a non-producer.

A gas-main explosion was the cause of this road-repair job in the High Holborn District of London. The highway is a main artery linking the east and the west sides of the city and had to be restored quickly to relieve serious traffic congestion. This was done by the Acme Flooring & Paving Company, Ltd., who placed the burden of the work on a 10x8-inch Type 20 portable compressor. This machine supplied ample power to operate as many as eight CC-45 paving breakers that had to deal with a thick layer of hard concrete.

HANDY RACKS FOR RIVETING HAMMERS AND SETS

IN shops where riveting hammers are extensively used much time may be saved through the proper storage of both "guns" and sets in the toolroom so as to make any particular pneumatic hammer and style of set readily available when wanted. Where space is at a premium, a pyramid rack is a very convenient thing for holding the sets. This may be placed right alongside shelves especially designed to carry the riveting hammers, thus making it possible to select the entire outfit without taking unnecessary steps.

The pyramid rack illustrated is of metal throughout. It consists of a central post of 2-inch piping fitted in a raised base in which it rotates, and of four disks each ¼ inch thick and varying in diameter from 1 foot to 30 inches. These disks or shelves are suitably perforated to accommodate sets of differing styles and sizes. The revolving pyramid rack offers a maximum of storage room upon a minimum of floor space, and it puts any set carried upon it within easy reach.

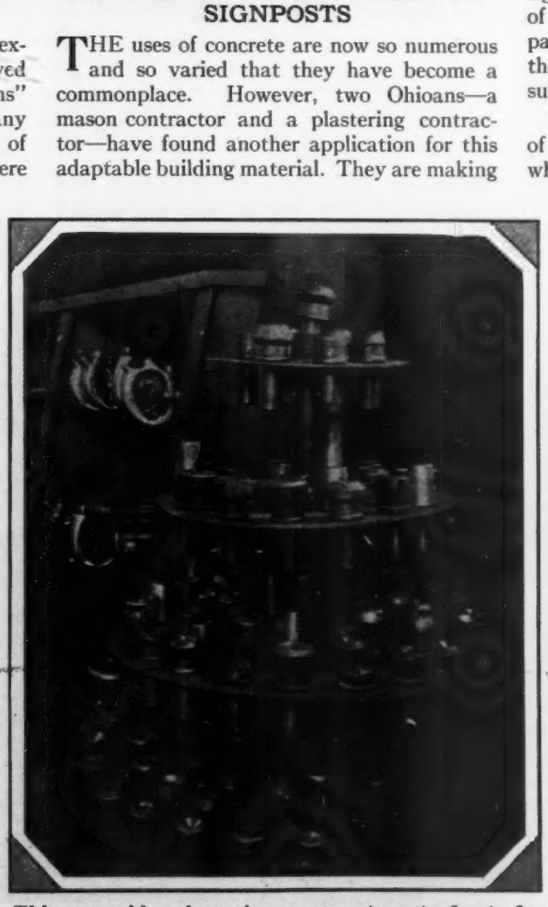
Great Britain is looking to Canada for a supply of helium gas for the two giant dirigibles now being built by her Air Ministry for transatlantic passenger service. The Dominion is known to have two sources of this noninflammable gas—the Bow Island gas field in Alberta and another smaller one in Peel County, Ontario. Their development on a commercial scale may therefore be reasonably expected in the near future.

SOMETHING NEW IN HIGHWAY SIGNPOSTS

THE uses of concrete are now so numerous and so varied that they have become a commonplace. However, two Ohioans—a mason contractor and a plastering contractor—have found another application for this adaptable building material. They are making signposts in which concrete takes the place of the billboard with its painted surface or paper poster. These concrete highway signs, though permanent, can easily be changed to suit requirements.

The new signs, says *Rock Products*, consist of a structural-iron and metal-lath framework which is covered with stucco so colored as to form a suitable and artistic background for the advertising matter. After this first coat has set, the face of the sign is given a second coat, of one or more contrasting colors, upon which the text and designs are outlined before the plastic mass has a chance to harden. At this stage the work must be done quickly, as the second coat, with the exception of the lettering and ornamenting, must be removed while the stucco is still soft. This leaves the message standing out in bold relief, sometimes 2 inches and more, from the background.

The number of colors that can be used in one sign is limited by the colors available for stucco; and it is claimed that they are little affected by the weather—being as good as new after a year's exposure. To change a sign, that is, to alter the reading matter, all that is necessary is to apply another coat of stucco and to repeat the operation, as described.



This pyramid rack carries an assortment of sets for the rivet hammers stored in the specially built shelves within convenient reach—a very handy toolroom arrangement.

After several years of research and experimental work, the South Manchuria Railway Company is now erecting at its Fushun collieries a shale-oil distilling plant. The plant is designed to handle annually 1,250,000 tons of shale which, at 4 per cent extraction, will yield 50,000 tons of crude oil.

Golden Gate Ferries Making Fine Record

These Diesel-Electric Boats Have Proved Economical and Especially Suited to Their Work

By R. G. SKERRETT

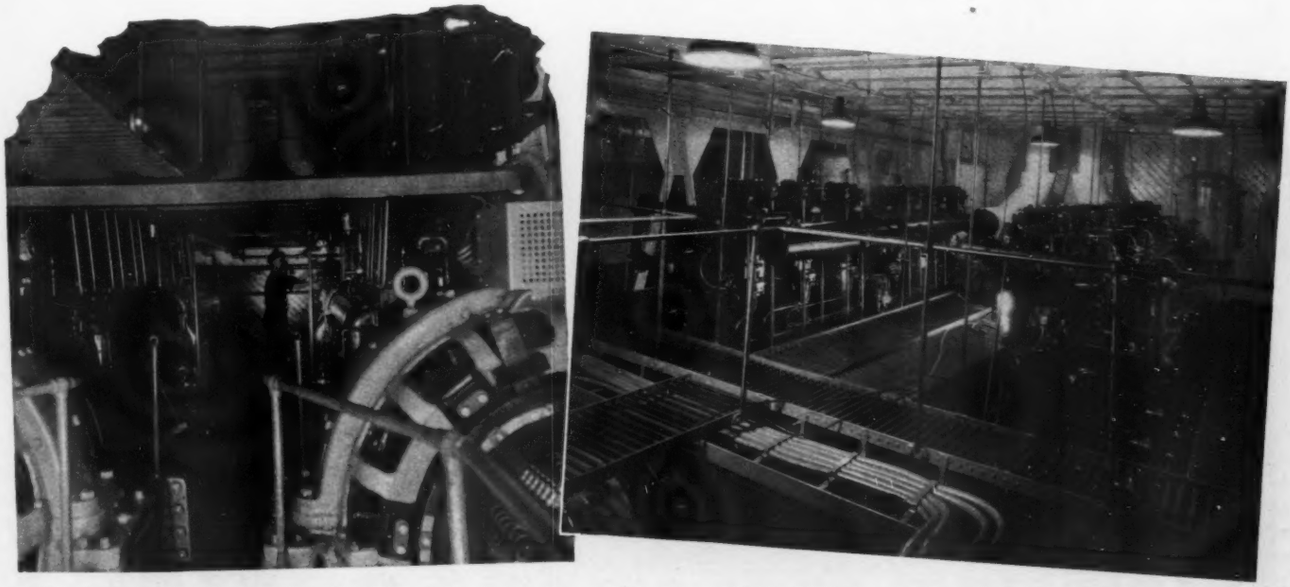
SAN FRANCISCO Bay narrowly escaped being a lake nearly 100 miles long and possibly 30 to 40 miles wide. But Nature decided otherwise by providing an outlet to the sea through a break in the towering hills that flank the bay on the west. Thus a safety valve, so to speak, was furnished for the Sacramento and the San Joaquin rivers during their seasonal flood periods.

The carving of the passageway to the Pacific, today known as the Golden Gate, changed the potential situation and brought about conditions that have affected the upbuilding and the utilization of the neighboring shores ever since civilized man first turned his attention to the development of California. Instead of being a lake, San Francisco Bay constitutes a splendid harbor that contains no less than 450 square miles of roadstead within which thousands of ocean-going craft could be accommodated easily.

The "Golden Poppy". One of the group of sister ships, equipped with Diesel-electric drive, owned and operated by the Golden Gate Ferries, Inc.

It is because of this distinctive physical advantage that San Francisco is the port of call for as many as 118 steamship lines; and in the course of a year the port handles as much as 39,000,000 tons of water-borne cargo having an estimated value of quite $2,120,000,000. This, and many other phases of economic growth, have come to pass mainly because on the present site of San Francisco a Spanish post and mission station were established in 1776. About 60 years later the mission was secularized and a town laid out there immediately afterwards. Yerba Buena, as the community was first named, was taken possession of by a United States man-o'-war in 1846, and was renamed San Francisco the year following. The town might have pursued its easy-going and slow evolution but for the discovery of gold that led to the rush of 1849. That not only changed the habit of life of San Francisco but gave the whole nation and the world at large a grasp of what Nature had contributed towards the establishing of a wonderful city on the Pacific coast.

As has been well said, San Francisco was born of the sea and for the sea, and her commercial greatness is, undoubtedly, very largely due to her superb harbor. But that harbor has had its drawbacks—the wide-spread area of navigable water serving to a degree to make San Francisco's position primarily an isolated one, located as she is on the peninsula south of the Golden Gate. As a consequence, towns and cities on the shores of San Francisco Bay, north, east, and south of the Pacific Metropolis, have come into being as consolidation points for freight destined to places scattered here and there throughout the entire length and breadth of the United States. In the course of time, certain of these railway centers have grown into important and sizable communities which, in their turn, have led to the upbuilding of smaller but thriving places—all of them linked by business or industrial in-



Left—Engine room of the ferryboat "Golden Poppy" viewed from below the grating. Right—Two of the "Golden Poppy's" Ingersoll-Rand oil engines photographed from the engine-room grating. The "Golden Poppy", like her sister ships, is equipped with three of these 400-hp. oil engines, each of which drives a Westinghouse generator and exciter.

terests with San Francisco, and all of them sending nearly daily a quota of their residents to the Metropolis.

In order to make this intercourse possible and to carry passengers to and from railway terminals on the east shore of the bay, especially, ferry lines were established; and, as years have gone by, the boats utilized in this service have been gradually changed so as to give the commuting or transient public the accommodations and the facilities considered up to date. Today, one sees a steady and frequent succession of ferryboats plying between San Francisco and the neighboring shores of this great landlocked body of water. The majority of the ferries enter and leave the slips at the foot of Market Street—San Francisco's principal central business thoroughfare, adding just that much to the congestion which is yearly becoming more and more serious.

But it is not with the ferries that focus upon the Market Street slips that the present article has to deal: its purpose is to describe the service performed by the Golden Gate auto ferries which have their starting point at the foot of Hyde Street, well to the west of Market Street, and which serve Berkeley on the east shore of the bay and Sausalito just across the Golden Gate. Like all alert and relatively new enterprises, the Golden Gate Ferries, Inc., profited by the previous experience of the older lines; and with all possible dispatch set about the upbuilding of a fleet of boats that would typify the latest practices in that particular field of naval architecture and marine engineering.

Top—San Francisco dock of the Golden Gate Ferries, Inc. Center—One of the Golden Gate oil-electric ferries underway. Bottom—Sausalito terminal of the Golden Gate Ferries, Inc.

The company's first object was to furnish Sausalito with a combined automobile and passenger service that would give that picturesque town not only a service that it sorely needed but one that would help also the rapidly developing communities lying beyond Sausalito in Marin County. In this endeavor, the company has been highly successful. Its activities have been marked not alone by a rapid increment of traffic but by an equally notable advance in property values and in the growth of the towns and countryside benefited by the better and ampler ferry schedule.

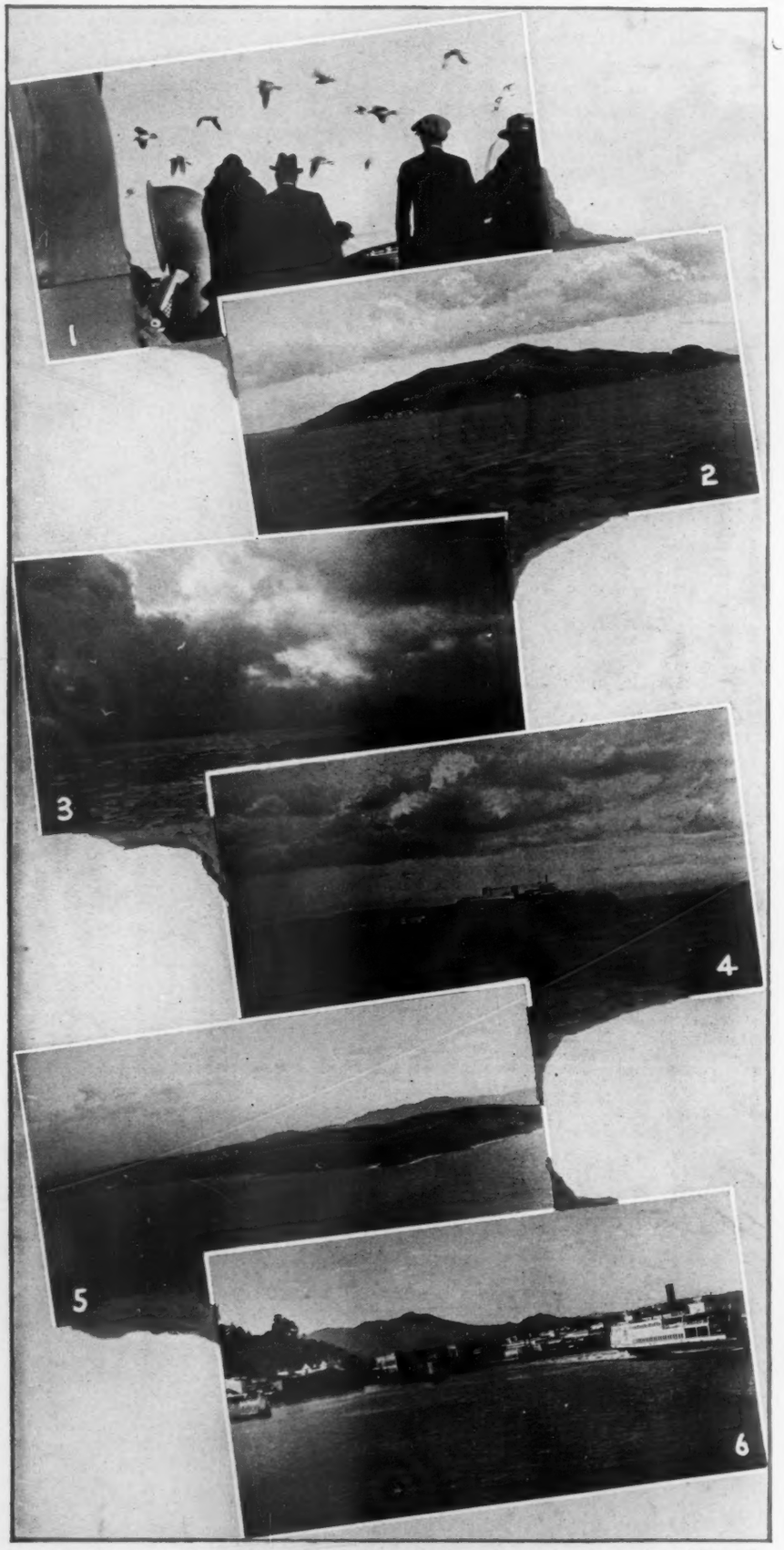
The Golden Gate Ferries, Inc., began active operations in April of 1922—the company having been organized the year before. It started its very welcome service between San Francisco and Sausalito with a single boat, a steamer. At that time a second vessel, the *Golden Gate*, was nearing completion. The *Golden Gate* was the first of the company's Diesel-engined craft, and was ready to be put on the run before the close of July of 1922. The fleet was amplified the next year by the commissioning of the *Golden West*—also a Diesel-driven boat.

The public response to the new line was instantaneous and enthusiastic; and traffic continued to increase at such a rate that the company, in order to meet the demand with the least delay, bought another steamer in 1925. That vessel was named *Harry E. Speas*. In 1926, the flotilla was augmented by the *Golden City*, which was "Dieselized" by the company; but that boat was sunk through a collision occurring after only a brief period of service. The same year the company built and commissioned the Diesel-driven *Golden State*.

In 1927, notwithstanding the fact that the company had four boats on the run between San Francisco and Sausalito—just four more than had previously been at the disposal of the citizenry of Sausalito and Marin County, the route became so popular that the Golden Gate Ferries, Inc., bought two steam craft from another harbor ferry route and remodeled them for the San Francisco-Sausalito run. Those vessels were named *Era* and *Dawn*, respectively; and they were purchased while still another ferry was under construction and nearing completion. This craft, the *Golden Bear*, was the first of a group of identical boats, all of which have Diesel-electric drive—each being fitted with three 6-cylinder engines developing a total of 1,200 hp.

Later in 1927, the *Golden Bear's* sister ships, the *Golden Poppy* and the *Golden Shore*, were finished and commissioned. With these fine boats added to their fleet, the company was in a position to carry out its scheme of wider service in San Francisco Bay by establishing a regular schedule between the Metropolis and Berkeley. The new route was inaugurated, with public demonstrations and suitable ceremonies, on June 15 of that year. Unlike the Sausalito-San Francisco run, the San Francisco-Berkeley line is devoted ex-

Various views of picturesque Sausalito taken both near the waterfront and high up on the scenic hill upon which the town is built. The towering ridge in the distance is Mt. Tamalpais, which lies to the north of Sausalito.



1—Feeding sea gulls is a favorite pastime of ferry passengers. 2—Angel Island looms high above the surface of San Francisco Bay. 3—San Francisco coming into view as the clouds lift above the bay. 4—Alcatraz Island is occupied by a United States military prison. 5—Looking toward the Presidio which guards the southern shore of the Golden Gate. 6—Docks of the San Francisco-Sausalito ferries.

clusively to automobile service; and, because of the shallow water for some distance offshore at the Berkeley end of the run, a pier had to be built extending out into the bay for 3⅝ miles. Prior to the establishment of this service, the people of Berkeley had been obliged to motor down to Oakland in order to get ferries that would take them to San Francisco. The citizenry of Berkeley are still enthusiastic over what has been done for them, and generally speak of the line as "our own ferry". The route has been a profitable one from the very start; and the *Golden Age*, the fourth of these typically up-to-date Diesel-electric ferries, was added to the Berkeley-San Francisco run in March, 1928.

It is worthy of note that the Golden Gate Ferries, Inc., after experience with steamboats and with direct Diesel drive, came to the conclusion that the Diesel-electric drive was the one best suited for the work expected of vessels in their particular department of harbor service. And it is equally significant that the last four ferries are identical in their propulsive equipment—the addition of the fourth boat being evidence of the satisfactory performance of the preceding sister ships. In short, the vessels represent repeat orders. For the sake of those that may be contemplating the building or powering of craft for ferry service, it might not be out of place here to mention what Mr. Clifford C. Brown, chief engineer and port captain of the Golden Gate Ferries, Inc., has had to say about these Diesel-electric boats. Mr. Brown has been identified with the company since its organization in 1921.

"The *Golden Age* and her three sister ships were put in service in each case after their Ingersoll-Rand oil engines had been given only a dock trial lasting about one hour. Since their commissioning, these vessels have been in virtually continuous service for eighteen hours a day; and have been idle, when traffic permitted, for five days every six weeks so that their engines could be gone over for the purpose of keeping them in first-class operating condition. This has not been because they needed overhauling, but as a matter of sound administrative policy. Indeed, both the *Golden Shore* and the *Golden Bear* have been operated continuously for periods of 90 days. The prime movers have amply proved equal to all that their builders have claimed for them.

"These engines have a notable advantage in that we can run normally with a development of about 900 hp. and, at the same time, have in reserve 300 hp. wherewith to meet weather conditions or to speed up the runs in case of delays occurring at either ends of the two routes. The fuel economies are all that should be expected; and the lubricating cost is exceptionally low—averaging 0.3 gallon per hour per ship. The Diesel-electric combination drive is a perfect one for a ferryboat, owing to the ease with which it meets all maneuvering requirements. The engine-room crew of each vessel consists of the engineer, his assistant, and a wiper.

Left—Sausalito, with Mt. Tamalpais in the distance. Right—The skyline of San Francisco above and back of the southern terminal of the Golden Gate Ferries, Inc.

"Each of these sister boats is equipped with Cameron pumps that provide circulating water for the engines and for other purposes; and there are two electrically driven Ingersoll-Rand auxiliary compressors that supply air for starting the propelling engines. This air is carried in a receiver charged to a pressure of 300 pounds. A second receiver, in which the pressure is maintained automatically at 100 pounds, provides air for blowing the signal whistle. The auxiliaries have proved just as satisfactory as the prime movers. Each 400-hp. oil engine is directly connected to a Westinghouse generator and exciter; and current from the generators is distributed to the motors that are directly connected to the propelling shafts that operate the screws at each end of the boats."

The run between San Francisco and Sausalito is a fraction short of 4½ miles, and the route is directly across the exposed sweep of the Golden Gate—at times compelling the ferries to maintain their schedules despite decidedly rough weather. Even so, it is unusual for the vessels to be delayed; and their success in this work is due to their sturdiness, seaworthiness, and the reserve of power provided by their oil-electric propelling plants. The water route to Berkeley is a shorter one, being only 3.8 miles; and this is due to the fact that the pier meets the boats a little more than halfway, as previously explained. The Berkeley line shortens considerably the run for motors bound to and from Albany, Emeryville, Richmond, Sacramento, and points north. Indeed, the San Francisco-Berkeley route and the San Francisco-Sausalito route make it possible for motorists to circle the northern half of San Francisco Bay and the whole of San Pablo Bay—crossing Carquinez Strait upon Carquinez Bridge.

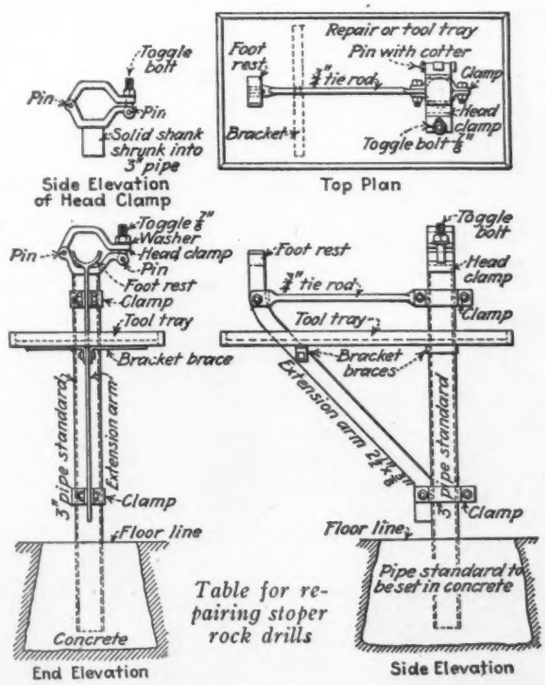
The boats are operated during the normal busy hours from 7 a.m. to 9.30 p.m. upon a 20-minute schedule; and during the remaining interval at sufficiently frequent periods to take care of traffic demands. Before the Golden Gate Ferries, Inc., put boats upon the Sausalito-San Francisco run, the people of Sausalito and Marin County generally were often seriously incommoded and obliged to wait hours in order to make the trip across the Golden Gate. Some idea of the betterment brought about by the institution of the Sausalito route becomes apparent when it is learned that in a single day as many as 9,000 cars have been moved to and from Sausalito and San Francisco.

In addition to the other conveniences and comforts afforded by these vessels, each ferry has a well-kept restaurant where good food at moderate prices is served. The run is long enough and the service prompt enough to make it possible to get a satisfying meal in the time available. During five out of every six week days, the company operates three boats on each of its routes, and then readjusts their schedules during the weekend rush hours so as to meet the increased volume of traffic. As explained by one of the officials of the company, "Our aim is to give the best possible service". Popular opinion is that the company has succeeded admirably.

SPECIAL TABLE FACILITATES REPAIR OF STOPERS

BY permission of the *Engineering and Mining Journal*, we are reproducing a line drawing of a repair table for stoper rock drills. This table is the work of John Williams, blacksmithshop foreman of the Old Dominion Mine, where it is in use.

In service, the head clamp is released and opened, permitting the stoper to be laid horizontally on the table with the foot end in the foot rest and the cylinder end in the head clamp. After that the head clamp is closed and firmly set into position by means of the toggle bolt. So placed, the machine is ready for the necessary work of repair. The table is equipped with a tray for tools and parts so that they may be within easy reach of the "drill doctor". It is said that this table has largely solved the problem of handling stopers quickly while undergoing overhauling or repair.



General arrangement and details of the stoper-rock-drill repair table.

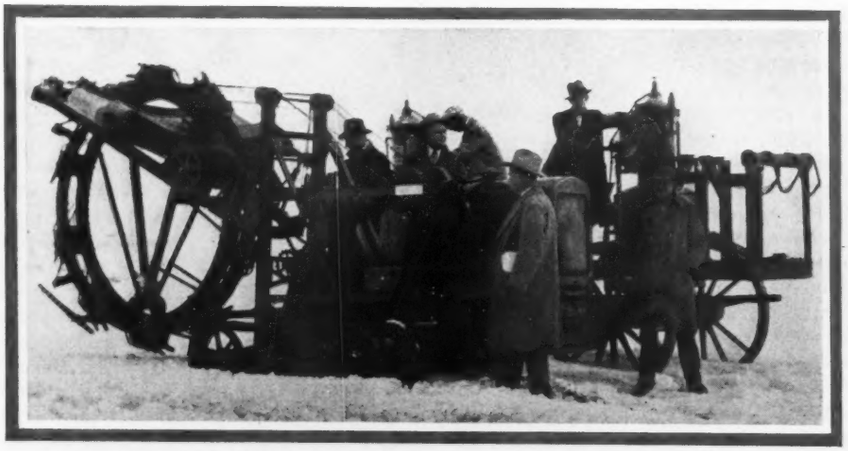
For the protection of workmen employed in crosscuts off the main haulage drifts, the Old Dominion Company has had designed and installed in one of its mines what has proved to be a very effective signal system giving warning of the approach of motor-driven trains. A whistle, made of a piece of ¾-inch wrought-iron pipe, is connected to the switch throw by means of a toggle arm and rod and also to the compressed-air line. The arrangement is such that when the switch is thrown to direct a train of cars into a crosscut, the whistle gives a shrill blast that cannot be ignored. This safety-first measure has so far put a stop to accidents caused by oncoming cars, as none has occurred since its application.

High up on a precipitous slope above the Little Tennessee, where the Knoxville Power Company is erecting steel transmission towers as a part of an extensive program of hydro-electric development. The "Jackhamer" in the foreground is helping to excavate a firm foundation for one of the towers.

Compressed Air's Part in the Laying Of a 210-Mile Pipe Line

By GAIL MARTIN

SINCE the first oil well was discovered half a century ago, the business of supplying natural gas for both industrial and domestic uses has grown enormously. Yet so commonplace is the act of touching a match to a burner and seeing a warming flame leap forth that one seldom stops to think of the complex engineering problems involved in placing natural gas at the disposal of the consumer. He is generally unmindful of the facts that the geologist must first locate the hidden reservoirs of gas and oil, lying sometimes thousands of feet beneath the earth's surface, and that drilling crews must work for weeks and months driving a hole down to the well to tap its wealth.



Power-driven trench digger and mobile plant for the generation of acetylene used in welding certain sections of the long pipe line.

Even after a field has been proved, only a beginning has been made. Pipe lines—hundreds and even thousands of miles long—must be laid at a great cost to furnish transportation. Trainloads of pipe lengths must be hauled; miles of ditch must be dug through mountain, forest, and plain; and many men must labor to link the pipe sections into one air-tight artery so that the householder and the manufacturer may draw upon the great pockets of natural gas concealed in the deep and rocky recesses of the subterranean world.

The building of a pipe line between the Baxter Basin area, in Wyoming, and Salt Lake City, Utah, a distance of 180 miles, by the Uintah Pipe Line Company, involved the use of considerable compressed air. Ordinarily, pipe lines are run from the field to the points of consumption so that the gas may be available subsequently for cleaning out the pipe and for testing purposes. But in the construction of the Baxter Basin-Salt Lake City line time was an important factor. Work was started in December, last; and because the rigors of winter made it prohibitive to start operations at the field, the usual procedure was reversed and the laying of the conduit was begun at the point of distribution. This meant that compressed air had to be used for testing and cleaning the line. These, however, are not the only services to which it is being put.

When the job was first tackled it was thought that the giant "ditchers" of the Buckeye and the Barber-Greene types would be able to break through the hard ground without any preliminary excavating. This it was found they could not do, as the ground was frozen from 9 to 18 inches deep. Then Ingersoll-Rand 7x6-inch and 8x6-inch Type 20 portable air compressors and CA-35 paving breakers were called into action to prepare the ground in advance of the ditch diggers. Where rock drilling and blasting is required, R-39 "Jackhamers" are used. Seven power ditchers are at work along the 210-mile front; and even with heavy frost in the ground each of these machines has been capable of making 1,800 feet of trench a day. In the summertime, under favorable conditions, such a digger can cover 1½ miles a day.

Between Salt Lake City and Baxter Basin the gas line is made up of 16- and 18-inch-diameter piping of the bell-and-spigot type.

An array of various power-driven equipment employed in preparing for and laying the 210-mile gas main between Baxter Basin, Wyo., and Salt Lake City, Utah.

This piping, manufactured by the A. O. Smith Company of Milwaukee, Wisc., represents a departure in this particular field of service and is being utilized for the first time on so big an undertaking by the Uintah Pipe Line Company. The units are made of cold-rolled steel, primed at the factory to prevent rusting, and combine lightness with great strength. The walls are but ¼ inch thick, as compared with ⅜ inch in the case of other kindred piping, and can withstand a working pressure of 400 pounds per square inch.

On arrival at the field, the separate pipe lengths are given a coating, about 1/16 inch thick, of heavy asphalt paint heated to 350° F. After the paint has dried, the bell-and-spigot joints are "stabbed"—that is, the spigot, which is 3 inches long, is driven snugly into the bell and "tacked" at four places with the electric torch. The welding dam at the spigot end abuts against the bell—the joint, after the completion of the welding operation, being transformed into a solid piece of metal that eliminates all danger of shearing.

Each joint is welded three times by a corresponding number of men who follow one another in succession, but with a sufficient time interval between welds to permit the metal to cool. Each welder is required to put a stencil or distinguishing mark at every joint, in this way making it possible to keep a check on the men's work.

At regular intervals in the line are placed expansion joints consisting of a piece of corrugated piping with a sleeve which fits snugly into the line and is made an integral part of it by welding. In mountainous stretches, where the main must follow many curves, there are 25 such joints to a mile to compensate for any expansion or contraction due to variations in temperature.

Pipe lengths, 30 feet long, are laid on skids and welded in the manner described into strings 500 or 600 feet long before they are lowered into the ditch by a Fordson "caterpillar" equipped with a side boom and a stiff leg. These sections are then joined—"bell holes" large enough for a welder to work in having been dug previously by the aid of air-operated paving breakers.

From two to five miles of the finished pipe line is tested at a time for leaks. The ends are sealed; and a pressure of 400 pounds to the square inch is then built up within by means of a 2-stage compressor. A Foxboro recording gage is mounted on the line. If it registers a drop in pressure, a search for leaks begins. Large leaks can be detected by the sound of the escaping air; but pin-hole leaks can be discovered only by the aid of soapsuds, with which the welds are coated. With this done, tractors and scrapers are used to backfill the trenches.

In the city limits, where new gas mains are to be installed, 8x6-inch portable compressors will be employed to operate paving breakers; Cleveland Baby diggers will do the excavating; and strings of piping will be tested with air at a pressure of 75 pounds per square inch. Between Salt Lake City and Ogden, there is being laid 10-inch seamless steel tubing. This tubing comes in lengths of from 39 to 43 feet with scarfed ends for acetylene welding. This conduit is being tested under an air pressure of 125 pounds per square inch.

The natural gas to be transmitted through the new pipe line will be derived from six big fields, developed in southeastern Wyoming, that are estimated to contain a reserve sufficient to supply the area under consideration for from fifteen to twenty years. These fields are: the North Baxter Basin, the South Baxter Basin, Hiawatha Dome, Clay Basin, Canyon Creek, and Alkali Dome. The venture involves an expenditure of $20,000,000, and is being financed by three major companies, namely, the Ohio Oil Company; the Producers & Refiners Company, which is a subsidiary of the Prairie Oil & Gas Company; and the Denning-Crawford group of capitalists which, for the last 40 years, has been active in the natural-gas industry.

GEORGE THOMAS COUSINS

TO the friends of George Thomas Cousins, the world over, we announce with profound sorrow his sudden death on the last day of June. Mr. Cousins was identified with the Ingersoll-Rand Company for a period of 30 years, and had been away from his office but two days on his annual vacation when he was stricken by heart failure. Those particularly that were associated with him daily will find it hard for some time to come to realize that they can no longer count upon his gracious smile and ever ready kindly counsel.

Mr. Cousins was born in Brooklyn, N. Y., on August 18, 1869. When he was only a few years old his people moved to Norwalk, Conn., where his father and his uncle engaged in the manufacture of shoes. George Cousins grew up in that atmosphere, and early displayed a notable mechanical bent. His gift manifested itself when he was still in his "teens". A complicated machine had been purchased for the shoe plant in Norwalk, and two supposedly qualified experts were sent to install it, but they could not make it operate properly.

George Thomas Cousins.

Unknown to any of his family, young George went down to the factory after hours and worked all night on the troublesome machine. He studied it thoroughly, located the difficulty, and when morning dawned he had the apparatus in running condition. The same exceptional ability to analyze an engineering problem made it possible for him in later life to diagnose with astonishing sureness the source of trouble in many forms of machinery that came to his attention; and this talent made him especially valuable in the designing field and in advisory service.

While a youngster, George Cousins studied mechanical drafting, after working hours, through a correspondence-school course, and in that way equipped himself for a position as a designer in the Norwalk Iron Works. When 24 years old he married Miss May Taylor of Meriden, Conn., who, with two daughters, survives him. In 1899, while engaged in engineering design work in Westfield, N. J., Mr. Cousins met Mr. Henry C. Sergeant, of the Ingersoll-Sergeant Drill Company, and was induced by him to enter the drill-designing department of that company at Easton, Pa. From that time on, virtually without a break, Mr. Cousins was identified with the Ingersoll-Sergeant Drill Company and with its successor, the Ingersoll-Rand Company.

After five years at the Easton plant, Mr. Cousins spent the next three years in the company's head office in New York City in promoting the sales of rock drills; and the following three years he was in Butte, Mont., as manager of the branch office there. He was highly successful in introducing the company's rock drills in that mining district. Subsequently, he was in charge of the branch offices in El Paso, Tex., and Johannesburg, South Africa. Owing to ill health, he returned to the United States after three years in South Africa. He took up work again in the New York office in the fall of 1913; and from that time onward he was in the company's Rock Drill Sales Department and had much to do in developing the paving breakers and the submarine drills produced by the Ingersoll-Rand Company. His special service, however, was that of straightening out engineering problems having to do with the operation of rock drills in the field and of showing how best those products could be utilized under specified conditions. His whole-hearted absorption in his work, his sincerity, and his comprehensive grasp of his subject made a deep impression upon all with whom he had dealings.

Mr. Cousins was very kindly to his young associates, and one of them pays him this tribute: "Mr. Cousins was one of the finest men I have ever known, both from a personal standpoint and in a business way. He was particularly desirous to help us young fellows, and painstaking to the limit in giving us the benefit of his ripe experience. I doubt if I shall ever have as good a friend again, and I know that I shall never have a better one."

St. Louis' New Lighting System

Millions of Dollars Are Being Spent to Illuminate Adequately Every Quarter of the City

By ALLEN S. PARK

THE City of St. Louis is aspiring to the distinction of having the best-lighted streets in the world. The aim is not the creation of intensely illuminated sections. On the contrary, St. Louis looks rather with disfavor upon so-called White Ways. The thing being strived for is the adequate lighting of every street and the slighting of none.

In its efforts to accomplish this end, the city is proceeding in a systematic and even scientific fashion. The degree of illumination of each street will vary according to its width the character of buildings facing it, the number of people and vehicles that use it, and other pertinent factors. However, the fixtures throughout the city will be uniform, and there will be no dark spots. Citizens of St. Louis go so far as to claim that it will be possible to read a newspaper at night at any point on any street. Whether or not this will prove true, it is a matter of record that in sections where the new system is already working, several residents have asked that the amount of light projected toward their homes be lessened—requests that have been heeded by using asymmetric refractors to reduce the intensity of the rays on one side of the lamps.

The determination of St. Louis to emerge from the darkness, as one prominent citizen put it, dates back six years. It was but a part of a larger conception of civic betterment—a desire for a more beautiful city that expressed itself in the issuing of $80,000,000 in bonds to be expended in various ways. Chief among the things already done or now being done are the widening of certain streets in the business district, the construction of a city plaza, and the erection of several attractive municipal buildings. Eight million dollars was set aside for the street-lighting system. Most of that sum has been spent; and it is now apparent that the total outlay, when the job is completed, will be approximately $13,000,000.

Close-up of a complete luminaire for a No. 1 lighting unit. The supporting fixture contains 150 pounds of aluminum and 140 pounds of manganese bronze.

The improvement will be all the more noticeable, aside from its value to the community, for the reason that heretofore the streets, even in the commercial sections, have been inadequately lighted. Some areas have had no lights; and the illumination that was provided came from a variety of types of electric lamps, arc lights, and gas lights mounted on an assortment of standards. Here and there, businessmen imbued with civic pride associated themselves to provide better facilities in small areas; but their enterprise served only to accentuate the contrasts and to emphasize the shortcomings of the street lighting as a whole.

St. Louis is one of the few cities of the Nation thus far to approach the street-lighting question in a methodical, intelligent way, and to deal with the entire city as a unit. Much study and research went into the preliminary investigations, after which the system was designed in a thoroughgoing, scientific manner.

It was recognized from the outset that, to be wholly satisfactory, street lights must

Left—A Type 20 portable compressor supplying air to operate an R-12 "Jackhamer" and a CC-35 paving breaker used in excavating the holes for the sockets. Right—His Honor, Mayor Victor J. Miller, finds that an air-driven paving breaker is easy to operate. St. Louis' chief executive and other city officials inaugurating the work on what is said to be the largest street-lighting contract ever awarded.

Left—The new standards are set back from the street corners to lessen the likelihood of damage from traffic accidents. Right—Tornado tested! This photograph, taken after the devastating storm of September, 1927, shows one of the concrete posts standing undamaged except for the globe, which was broken. Bottom—One of St. Louis' business streets, showing the close spacing of the standards.

meet both aesthetic and practical requirements. They should not only look well by day and by night, but should also function in such a manner as to decrease crime and street accidents, thus adding to the general prosperity and well-being of the community at large.

To determine the most suitable means of fulfilling these desiderata, all available types of equipment were investigated and considered in the light of the numerous factors involved—such as power per lamp, height of lamps from the ground, location of standards, distances between standards, etc. Then followed a period of tests, during which various kinds of lighting units were erected on selected streets and compared as to appearance and illuminating effectiveness.

Under the new system, 32,000 gas lamps and 2,750 arc and incandescent lamps will be replaced by approximately 60,000 incandescent lamps. It will provide 7,560,000 candle power as compared with the 3,160,000 candle power formerly available. In addition to increasing the light two and one-half times, it is estimated that a saving of 8 per cent will be made on the old operating cost of $1,000,000 a year.

The standards adopted are "Hollowspun" concrete posts, which support single-piece globes of deformed diffusing glass. The mountings are ornamental in design, and cast partly in aluminum and partly in manganese bronze, both of which metals are non-tarnishing. The standards, a product of the Westinghouse Electric & Manufacturing Company, are octagonal in section, and taper from base to top. They are made by rotating, at high speed, a metal form containing the concrete and the reinforcing cage. Red-granite chips constitute the aggregate used in the concrete. The posts are finished by treating them with dilute hydrochloric acid. This removes the lime from the surface of the cement, giving the exterior faces the color and the general appearance of granite.

All wires are carried in underground conduits. Near the top of each standard are castings designed for attaching the wires used to support street-car trolley wires. But as there has been in effect for several years a city ordinance requiring the public-utility companies to remove a certain number of miles of poles each year, the future St. Louis will be noteworthy for the absence of overhead wiring and the generally unobstructed appearance of its streets.

The lighting system is being installed by districts, each of which constitutes a separate contract. Four districts have been finished, and steps have been taken to put a fifth under construction. The work in District A is of especial interest because it included the installation of the lighting system in the city's principal business center. This contract was handled by the G. L. Tarlton Company, of St. Louis, at a bid price of $2,235,985; and it is said to be the largest individual street-lighting contract ever awarded. Work was started on April 3, 1928, and was completed in a little more than eight months. The lights were placed in service last December.

The Tarlton contract called for the furnishing of all materials, except the incandescent lamps, and for the performance of all work incidental to the installation of the system, ready for operation. The chief items involved in carrying this out were: equipping an electrical substation; constructing an underground conduit system, complete with wiring; and erecting the lighting standards and equipping them for service.

For supplying the required electrical energy to the lighting standards, the "constant-potential, constant-current system" is employed. This consists of primary circuits to distribute 2,300-volt, 3-phase, 60-cycle current from the substation to transformers placed in manholes. The transformers are in pairs, and are designed to supply, in some instances, 6.6 amperes and, in others, 20 amperes constant current to secondary-series circuits, each of which serves a group

of lighting standards.

Current is purchased from the Union Electric Light & Power Company, and is delivered to the substation by two of four available circuits. The substation is of the automatic type. An astronomical clock, which changes with the seasons, turns on the current at a predetermined time each evening and turns it off each morning at the hour set. The automatic features not only save labor, but serve as a protection against human error. Except for cleaning and oiling of movable parts and for general work around the station, no attendance is required.

A total of 4,375 "Hollowspun" posts was installed in District A. They are of four types, which vary in diameter, height, and in the luminaires or lighting fixtures that surmount them. On 752 standards, known as the No. 1 lighting unit, the luminaire consists of a double-arm bracket supporting on each side an incandescent lamp enclosed in a blown-glass globe. Most of the lamps are of 1,500 candle power, or 3,000 candle power to the post, though a few are of 2,500 candle power. As mounted on the posts, these fixtures are 26 feet above the street surface, the posts being 23 feet high. There are 774 No. 2 lighting units, each composed of a 23-foot post with a single-globe luminaire containing an incandescent lamp of 1,500 candle power. The No. 3 unit is made up of a single globe, with a lamp of 1,000 or 600 candle power, mounted at a height of 19 feet 2 inches above the street. The No. 4 lighting unit has a 250-candle-power lamp mounted 14 feet 9 inches above the street.

The enclosing globes on these units are semi-diffusing. They consist of two layers of glass, the outside layer being clear and relatively thick and the inner layer opalescent. The exterior surfaces are rippled to diffuse the light. The globes are annealed to render them insensitive to temperature changes and to ordinary impacts and vibrations arising from street traffic.

The posts are placed on the sidewalk so that their outside faces are 18 inches in from the curb; and the average distance between standards in this district is 110 feet. They are arranged in lines so disposed in relation to each other that individual posts on either side of the street are directly opposed. At street intersections, posts are set 15 feet back from the corners. This is close enough to the center of the crossing to provide adequate illumination and far enough removed to escape most of the traffic accidents that occur at such junctions.

It was essential that business be disturbed as little as possible by the installation work; and by reason of efficient organization and intelligent planning the contractor kept interference with traffic down to a minimum. A force of 700 men was engaged on the contract; and the various operations were so laid out that those tending to block traffic to an appreciable degree were carried on at night. All post-setting, for example, was done during the hours when the streets were practically deserted; and the new standards sprang up under cover of darkness as though by magic.

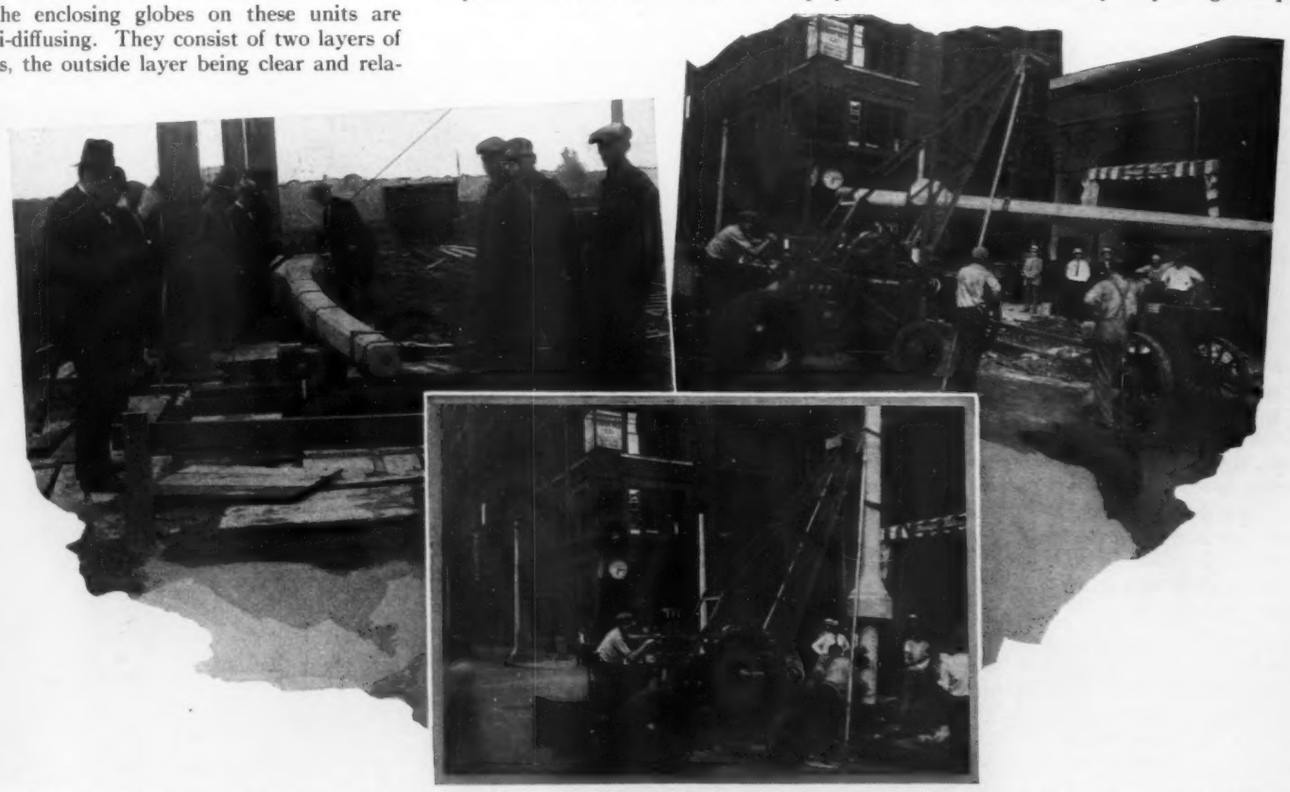
The method of putting the posts in the sockets prepared for them is illustrated by accompanying photographs. A tractor with a special derrick attachment was employed to lift the posts from the trailers on which they were delivered, to raise them, and to drop them into place. They were speedily handled by this equipment, despite the fact that the uprights for the Nos. 1 and 2 lighting units weigh 3,600-3,800 pounds each.

Portable compressors and air-operated tools did much to expedite progress on the great amount of excavating required in trenching for conduits and in digging manholes and openings for posts. The equipment for these operations consisted of six Ingersoll-Rand Type 20, 5½x5-inch portables, R-12 "Jackhamers", CC-35 paving breakers, 3R chipping hammers, and I-R tamping pads for use with the paving breakers on backfill work.

The general method employed in trenching for conduits was to remove the paving with paving breakers and then to dig to the required depth with hand tools. Alternate sections a few feet in length along the line to be excavated were opened in this way. Between these sections the earth was tunneled by hand tools, thus leaving the intervening street surface undisturbed.

All wires are encased in fiber ducts 3½ inches in diameter. The conduits were built of concrete in the usual manner; and carry from one to eighteen ducts. Where the conduit is of the multiple-duct type, concrete spreaders were placed between the several rows of ducts. Although it was necessary to run conduits across streets at many points, the work was carried on in such a manner that in no instance was traffic held up longer than ten minutes.

As can be seen by inspecting the photo-



Left—The concrete lamp posts must withstand considerable bending stresses without fracturing. This picture shows a test in progress. Right—Unloading a 3,800-pound post from a trailer. Trailers of this type were used to deliver the standards at night and to put them in position with the aid of a specially constructed crane. Bottom—Lowering a lamp post into its socket.

Demonstrating the size of the largest globe used in the St. Louis lighting system.

graphs, the posts are made with a shoulder or lug at the point which comprises the base of the standard when set. Below this shoulder is a butt, some 6 feet in length, which extends into a concrete socket prepared to receive it. These foundations are built of reinforced concrete around a special metal form. The posts fit snugly in their sockets, but can be removed by merely lifting them out.

In 325 cases, these foundations had to be constructed either wholly or in part in basements extending out beneath the sidewalk. Concrete was built up in such instances as much as 12 feet 3 inches. As the first step in making the excavation for these structures, a "Jackhamer" drill hole was sunk through the sidewalk in the center of a 44-inch square defining the boundaries of the opening to be made. This drill hole was in the nature of a prospect opening to determine the presence or absence of retaining walls or other obstructions and to reveal the exact character of the material below.

A total of 75 transformers and pulling manholes were included in the contract. Twenty-one of these are each 26 feet long and 9 feet wide, and have 8 feet of headroom. They are constructed of reinforced concrete, with frames of brick leading to manhole covers at the street level.

All electrical equipment entering into the contract is of Westinghouse manufacture. The posts were made in that company's St. Louis plant. The aluminum and manganese-bronze castings were produced in St. Louis foundries. Luminaires of the No. 1 type contain 150 pounds of aluminum and 140 pounds of manganese-bronze.

The street-lighting system was installed under the supervision of J. C. Pritchard, director of public utilities for the City of St. Louis; and J. C. Hail, general manager of the G. L. Tarlton Company, was in charge of the work for the contractor in District A.

IMPROVED TYPE OF ROLLING MILL FOR STRIP STEEL

THE demand for strip steel of greater widths than those for which present-day rolling mills are generally designed has resulted in the building by a large German machine works of a semi-continuous rolling mill that is said to satisfy all the requirements of the Vereinigte Stahlwerke, A. G., in whose Dinslaken plant it is installed. This special machine is capable of turning out strip steel ranging in width from 4 to 18 inches and in thickness from 0.05 to 0.12 inch—delivering it in coils weighing up to 600 pounds. While having a rated output of 120 tons per shift, the mill, it is claimed, produced under service conditions a maximum of 130 tons of 8-inch strip 0.12 inch thick. A slab bloom, measuring 11x3x40 inches, is rolled down into strip 11 inches wide and 0.11 inch thick in not more than 48.5 seconds.

A crew of but four men and a superintendent are in attendance while rolling is in progress—most of the operations being done mechanically. Electric motors furnish the driving power; and considerable compressed air is used at different points and for different purposes along the line of travel Starting with the charging end, compressed air helps to eject the bloom from the heating furnace. Next, air pressure plays a useful part in sending the rough-rolled strip on its way to the first pair of rolls on the finishing train. If the specifications for the product in course of manufacture are very exacting, then a pneumatic scaling device and a jet of compressed air are called into action before the strip reaches the next pair of rolls. The scaling device consists of two rigidly mounted knives between which is placed a third knife that is brought down on the moving strip by air pressure. This serves to loosen the scale, which is scraped off by the two other knives.

Prior to entering the top finishing rolls for the last pass, the strip is freed of scale, if this has not already been done, and cleaned by a blast of compressed air. But air has still one more duty to perform at the very end of the strip's journey: it operates a device that forces the coiled material from the winding machine.

A STEP FORWARD IN TELEVISION

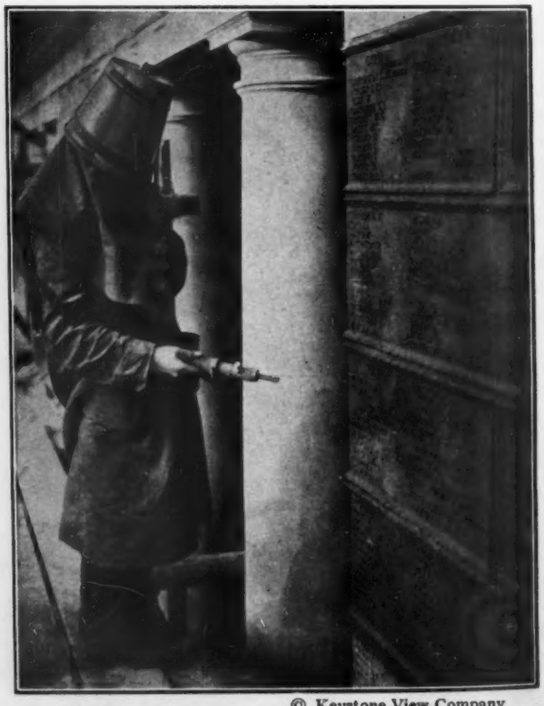
A TELEVISION apparatus that can be attached to the ordinary radio set as easily as a loud speaker was demonstrated recently in Berlin, Germany. The apparatus appears to be designed primarily for the long-distance transmission of moving pictures.

The tests indicated, according to *Commerce Reports*, that the machinery is capable of projecting ordinary motion pictures by wire or wireless to several receivers in different places simultaneously.

During the demonstration the attendant turned a button, and immediately a picture appeared in the aperture of a square frame similar to a mirror holder. Detailed action scenes were flashed with remarkable clearness. Not only were light and depth reproduced, but intermediate tones stood out almost perfectly.

In the sending room the film was run through an ordinary motion-picture apparatus. The picture fell on an aperture in the transmitting apparatus, where it was touched by light rays. These rays touched at approximately 1,000 points a second. Transferred then into electrical impulses, the pictures were transmitted to an apparatus so simple that it could be plugged into any radio receiver precisely as a loud speaker is employed.

According to information received from Nova Scotia, eel or barnacle grass, which grows abundantly in the shallow waters along the Atlantic coast, makes an excellent building material that is both heat and soundproof. A special machine has been devised for the quilting of the grass, which is now being harvested and thus put to commercial use.

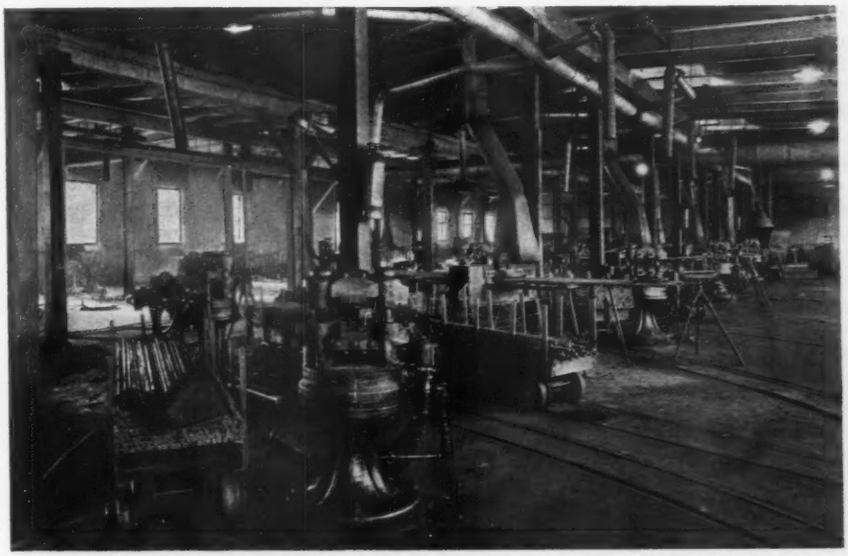


© Keystone View Company

Protecting garb of a "bogyman" engaged in sand-blasting the bronze plates on the Mercantile Marine Memorial in England.

How the Hollinger Handles Drill Steel

ONTARIO can still boast America's richest gold producer in its rightly famous Hollinger Mine inasmuch as that mine has yielded, up to the end of 1928, gold to the value of $145,000,000. The production of so much gold has entailed the mining and the milling of 17,000,000 tons of ore, and this, in turn, has necessitated a great deal of development work. How much can be gathered from the following particulars concerning that work, which is also suggestive of the magnitude of the Hollinger.



Lengthwise view of the big centralized blacksmith shop of the Hollinger Consolidated Gold Mines, Ltd., showing the arrangement of the drill-steel sharpeners and the oil furnaces, and the type of cars used to carry the steels to and from the mine.

Up to and including 1928, when the mine's underground workings were extended more than 17.5 miles, the development footage drilled had come to a total of 659,949 feet—consisting of 16,413 feet of shafts, 296,230 feet of drifts, 319,189 feet of crosscuts, 26,911 feet of raises, and 1,206 feet of winzes. Besides this, 764,823 feet of exploratory drilling had been done. Just what these figures mean can be appreciated only when it is understood that the Hollinger's present subsurface workings, if placed end to end, would reach from New York to Albany and a little beyond, a distance of nearly 150 miles, and that its underground railroad system has a length of more than 91 miles.

While the past activities of the Hollinger have measurably cut down the ore reserves, large deposits of gold-bearing ore are known to exist, thus assuring a continuance for years to come of the large-scale operations which have hitherto characterized the performances of the Hollinger Consolidated Gold Mines, Ltd. Needless to remark, the burden of the work rests upon the modern rock drill, of which something like 225 are in daily use throughout the mine. These machines require a considerable tonnage of drill steel—to be specific, 3,000 steels each shift, or 6,000 a day.

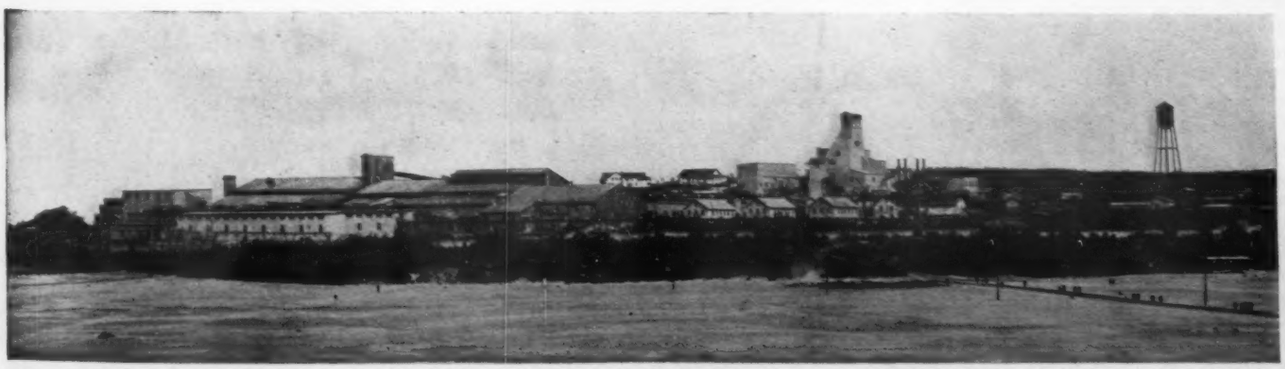
It may interest some of our readers to learn that $\frac{7}{8}$-inch, quarter-octagon steels are used with $1\frac{5}{8}$ inch bits on the starters. The steels are changed every 18 inches, and the change in gage of the bits is at the rate of $\frac{1}{16}$ inch per foot drilled. The bits are 14° and 5° taper, with 90° cutting edge.

For conditioning the 3,000 steels needed each shift, the blacksmith shop is equipped with twelve air-operated sharpeners; and of this battery one is held in reserve so as to permit of the systematic overhauling of each machine from time to time without interfering with the maximum operating efficiency of the sharpener plant. This blacksmith shop takes care of all the steels used in the mine, and is not only a large one but a thoroughly up-to-date one. Each sharpener in service handles from 250 to 300 steels per shift. All sharpeners are of the Ingersoll-Rand type, and are equipped with IRLP shank and bit punches. The fact that the plant has standardized on a single make of sharpeners, which are expected to do very exacting work, is ample evidence of the excellence of these machines.

The procedure followed in handling drill steel is the outcome of some years of experience in dealing with a decidedly important department of the work at the Hollinger. The steel-sharpening practice has been developed by Mr. A. F. Brigham, general manager of the mine, and Mr. Richard Eddy, superintendent of the sharpening shop.

All dull steels are gathered underground on special round-bottom cars with high ends. These cars are run on to the cage in No. 11 Shaft and hoisted to the surface, where an electric locomotive takes them and switches them on to the track leading to the blacksmith shop. As the cars with their loads are needed they are rolled into the shop; and just inside the door the steels are assorted and placed, according to length and gage, on flat-top trucks. This assures each sharpener a steady supply of the particular kind of steel it is working on.

Steels to be straightened are placed on a separate car regardless of length and gage, and are hauled to a straightening machine—an old sharpener which has been equipped for the work with special dies and a foot control bar. Those that need to have the shanks refaced or the holes opened are sent either to an electrically operated emery wheel or to a specially constructed air-operated tool in the shape of a lathe. New steels are transferred from the cars in which they arrive at the property right to the stock platform located at the receiving end but outside of the blacksmith shop. At this end, and close to the



General view of the surface workings of the great Hollinger gold mine in the Porcupine district of Northern Ontario, Canada.

sorting track, are the forges where moils, bars, and wedges are sharpened.

For heating the steels there are six oil furnaces, one for two sharpeners. These furnaces have been designed in the Hollinger shops; and each has two opposed openings. It might be said here that there is plenty of elbowroom around the sharpeners and their furnaces, as elsewhere in the shop, to enable the men to work freely.

After a steel has been sharpened, a wire pin is put in its shank and a record made of the number of steels sent to the hardening furnaces. There the pins are removed and counted so as to keep a check on the steels passing between the sharpeners and the hardening furnaces. These, like the oil furnaces, have two openings and are a product of the Hollinger plant. They burn oil and use high-pressure air. The finished steels are stored in racks within convenient reach of the furnaces, and there they remain until wanted in the mine. Then they leave the blacksmith shop by a side door in cars running on a spur that connects with the line leading to the shaft that takes them underground.

The blacksmith shop is 80 feet wide and 310 feet long; it is light and well ventilated; and is complete in every respect with a tool-room, clothes lockers, toilets, washrooms, and an office for the superintendent. The management is and may rightly be proud of this centralized steel-sharpening shop, which is considered not only one of the largest of its kind in the Dominion but one of the best arranged and equipped, as well.

GOVERNMENT-OWNED MOVIES WIDELY CIRCULATED

PROBABLY few of us are aware that the United States Government—the Bureau of Mines, to be exact, is the owner of an unusual circulating "library". Instead of carrying books on its shelves it houses moving-picture films portraying the nation's mining and metallurgical industry. These films, like the books in a public library, are available for free distribution, and are shown the nation over for purposes of instruction by educational institutions, army and navy posts, churches, clubs, chambers of commerce, and many other kindred organizations intent on disseminating information. In fact, so well known has the service become that copies of certain of the "movies" are being sought abroad.

Not long ago the Japanese Bureau of Social Affairs bought four of the Bureau's films which were shown in that country during the course of a general industrial safety campaign. The Province of Quebec Safety League was another purchaser, and that organization arranged for the showing in nearly every movie house in Quebec of the picture entitled, *Carbon Monoxide—the Unseen Danger*. No amount of literature could possibly have brought home to the public in so short an interval and so graphically the dangers of this noxious gas to which every automobile owner is subjected.

The chief distributing center for these films is the Pittsburgh Experiment Station of the United States Bureau of Mines; and all that is required of the borrower is that he pay the cost of transportation to and from any one of the thirteen subdistributing stations. The collection owned by the Bureau is believed to be the largest of its kind in the world, and includes 525 sets of films consisting of 1,411 reels.

INVENTOR OF KLYDONOGRAPH WINS LONGSTRETH MEDAL

AT the last medal meeting of the Franklin Institute in Philadelphia, Pa., John F. Peters, eminent consulting engineer of the Westinghouse Electric & Manufacturing Company, was awarded the Longstreth Medal for his invention of the "klydonograph", a device that automatically records the effect of lightning as it strikes an electric transmission line. The instrument's name is derived from the Greek words *kludon* and *graphos* meaning, respectively, a billow or a wave and writing.

Lightning is the most elusive and destructive of the agencies harmful to the uninterrupted transmission of electric power; and until Mr. Peters produced his klydonograph, in 1923, there was nothing available that was quick-acting enough to register the effects of lightning strokes, which do their damaging work in a few millionths of a second. During laboratory tests, with artificial lightning, the klydonograph has recorded flashes lasting less than ten billionths of a second!

The klydonograph is a very sensitive 8-day camera that now stands guard on many electric transmission lines in the United States for the purpose of indicating the magnitude, the polarity, the steepness, and the direction of travel of the destructive bolt. Once put in position it requires no further attention than a weekly change of photographic film—clockwork turning the roll of film and also telling the time at which the lightning struck. The imprint of the flash on the developed film is as symmetrical and beautiful as is the structure of a snowflake when seen through a powerful microscope. This imprint is an open book to the scientist, as he can tel by the size, intensity, and arrangement of its lines the characteristics of the lightning thus recorded for him. It is by means of this simple device that data is now being gathered the country over on the effects of lightning on power transmission lines.

CURIOSITY IN BUILDING MATERIALS

HOUSES of a stone that can be nailed, sawed, and painted any color, like wood, are to be erected in many of the principal cities of the Soviet Union, according to *Stone*, which goes on to say that great deposits of this curious building material have been discovered in the Town of Artig, Armenia, which is a member of the union.

The deposits are of lava formation, and are estimated to contain 78,500,000 cubic yards of this curious stone. Artig tufa, as it is known locally, is said to be tough though light in weight; capable of withstanding great strain; heat and sound resistant; and as well suited for the making of furniture as for the walls of the structures housing it.

Rubber instead of metal trays are being supplied with some electric refrigerators to facilitate the removal of the ice cubes, according to the Canadian Department of Agriculture. They are easily emptied, without the use of hot water, by flexing the container and ejecting the separate pieces of ice by a pressure of the thumb. The trays are made of tough white rubber.

Mr. John F. Peters with his klydonograph that won for him the Longstreth Medal.

London Creating a Superpower System To Meet Growing Demand for Power

Problems Involved in Laying Interlinking Cables Across Busy Southwark Bridge

By H. B. COLLARD*

DURING the last few years the problem of London's electricity supply has become more and more acute. The big increase in the amount of current used in all sections of the community has necessitated the erection of newer and larger generating stations and the laying of many miles of cables.

To facilitate the unification of this work, it was planned to amalgamate many of the existing companies; to purchase all the generating stations in the area; to rely on the most efficient of them to carry the base load; to close down uneconomical plants; and to erect new stations where needed.

Special trailer provided to carry the 1,221-foot cable lengths made to span Southwark Bridge. Each supertension cable, complete with drum, weighed more than 11 tons.

By the London Electricity Acts No. 2, passed in August of 1925, the generating assets of ten of these companies were transferred to the London Power Company which, in return, was to supply power to ten companies for local distribution. It is estimated that the whole scheme of interlinking these stations and equipping new ones will not be completed for some years.

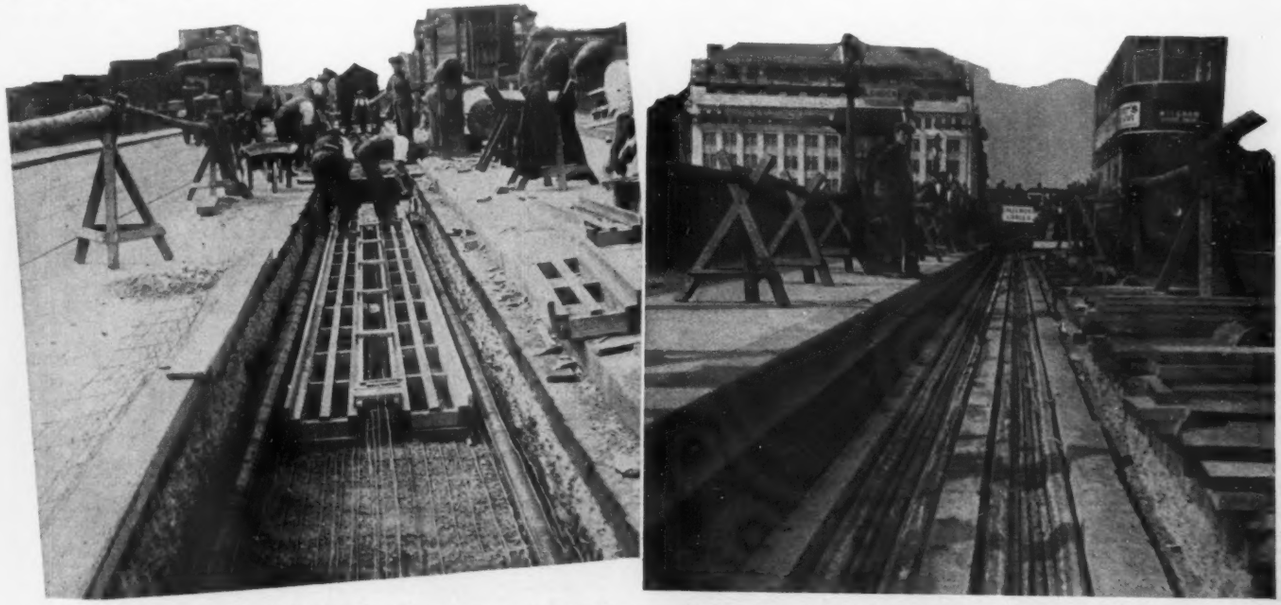
As can be imagined, innumerable difficulties have been encountered in connection with the laying of cables to link up the various stations. At times these had to be run a few feet beneath the road surface, at others at a depth of more than 20 feet. For the most part they had to be carried through main thoroughfares; and, in order to interfere with traffic as little as possible, it was of paramount importance that the work be done with the utmost dispatch.

The contract for the cable-laying in a section of the district in question was awarded to Messrs. Callender's Cable Company, an organization of world-wide repute, which is also the maker of the cable. This company has for some years appreciated the value of compressed-air tools in speeding up its work and in keeping down costs. At the present time, it owns a fleet of portable air compressors and scores of air-driven tools which are being used the country over on its various undertakings. The contract under consideration covered the cable-laying over Southwark Bridge to link up the Deptford and Cannon Street stations. The work on this section was begun on July 31, 1928, and the cables were pulled on August 16, making a total of seventeen days from start to finish.

The demolition equipment on the job consisted of seven Type 20 portable air compressors operating 28 CC paving breakers and other pneumatic tools. In order to appreciate to the full the speed with which this work was carried out, it is necessary to understand the difficulties which were encountered and the general nature of the work.

A trench, measuring 4 feet wide by 2 feet deep and 1,176 feet long, had to be excavated for the full length of the bridge. This trench was run between the trolley lines and the pavement, with only a few inches of clearance; and all the equipment used had to be kept within those confines. In all, 262 cubic yards of concrete had to be removed; but the nature of the work was such that, had an attempt been made to use hand methods instead of a

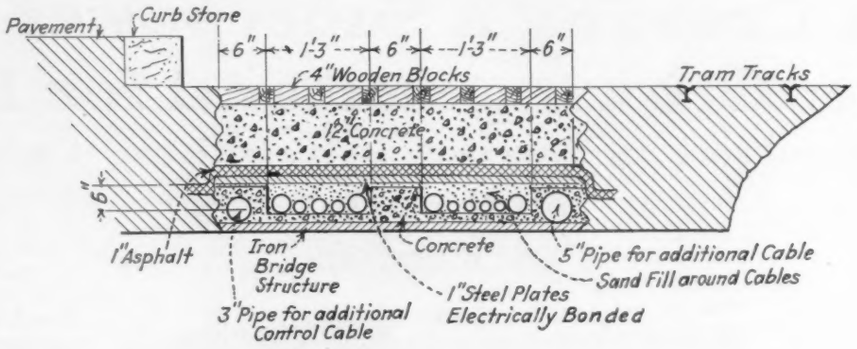
*Engineer in charge of work, London District.



Left—Forms used in making the reinforced-concrete chase. Right—Chase with the eleven cables in position and ready for the laying of the steel plates.

compressed-air plant, cross-river traffic would have been disrupted for a much longer period.

Considerable difficulty was experienced in breaking out the concrete, which was 18 inches thick. This was laid directly on the iron floor of the bridge, and formed a solid mass with no give to it. Owing to its thickness and to the solid foundation on which it rested, it was found that the concrete would not break away in large lumps after the steel had penetrated part way. Instead, the steels had to be put down to within an inch of the iron base, after which comparatively small pieces had to be literally pried loose, using the paving breaker as a lever. In addition, far more cuts had to be made to break out a cubic yard than would have been necessary under ordinary conditions.



When the trench had been excavated, a reinforced-concrete chase was made to carry the cables. This was necessary, owing to the fact that the cables running across the bridge had to be laid fairly close to the surface. The chase was formed of reinforced concrete with a partition in the middle to support the steel plates covering the trench, and steel pipes were laid on either side of it. These pipes were provided for additional cables, should future demands necessitate an increase of the transmission system.

The concrete chase was finished on August 14. The next operation was that of pulling the cables through it. The cables for this particular section were made especially in lengths of 1,221 feet so that they would reach from end to end of the bridge without joints. To accommodate these cable lengths, drums had to be made to order. These measured 10 feet 2 inches by 4 feet 6 inches, and weighed, complete with cable, 11 tons 5 hundredweights. It is estimated that these were the heaviest drums ever handled in London. Again, special transportation and mounting facilities had to be arranged—the truck and trailer used being illustrated.

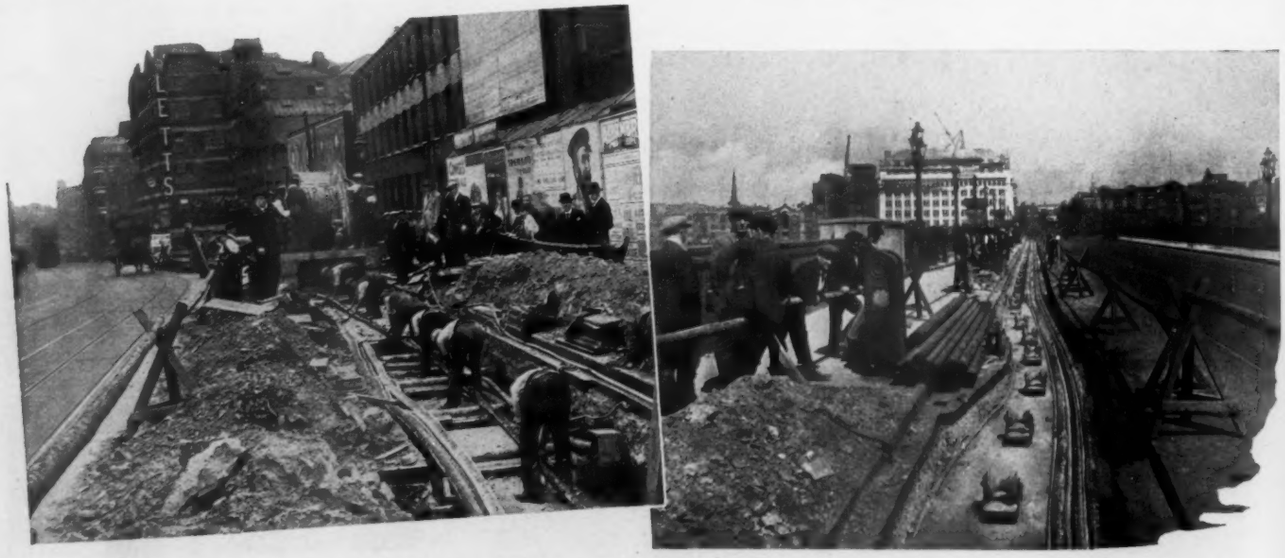
For cable-pulling, 120 men were employed spaced at equidistant points throughout the length of the bridge. In order to obtain an even pull, a platform was erected at the crown of the span, and from this signals were given to the men. In all, eleven cables were thus laid. These consist of four 3-core, 25-square-inch, 25,000-volt supertension cables; four combined pilot and telephone cables for the protection of the system; two 25-pair, dry-core telephone cables; and one 21-core control cable. The total time taken to do the pulling was from 8 a.m. to 4.30 p.m., or 8½ hours. The cables are of cadmium alloy sheathed against vibration, as it has been found that ordinary lead-covered cable tends to crystallize with continued vibration due to heavy traffic.

With the cables in position, the next step was to fill in the chase with sand and to tamp it tightly. The chase was then covered in its entirety with mild-steel plates designed to carry the load. These plates measured 4 feet by 1 foot by 1 inch; and, in all, 965 were used. The plates were then electrically bonded with a 1-inch copper strip.

On top of the steel plates was laid a covering of asphalt 1 inch thick; and in this work air tools, again, proved invaluable. Owing to the special construction of the trench, it was found that the surface of this layer of asphalt was above the level of the asphalt in the rest of the roadway. To make these two levels meet, it was necessary to trim the road surface back from the edge of the trench so as to expose the edges of the old and the new levels. This was done with 56-H picks fitted with moil-pointed steels. By their use, it was possible for the men breaking out these sections to keep ahead of the asphalting gang and thus to hasten the work. On top of the asphalt came approximately 12 inches of concrete, and on this, in turn, were placed the wooden blocks forming the surface of the roadway.

During the laying of these cables, many indications of Roman London were discovered. In the districts from Cannon Street Station to The Monument, and between Kensington and The Embankment, the cables were at times sunk to a considerable depth. For example, near Sloane Square, a depth of 22 feet was reached—the cables passing under the old Westbourne River. This river has shrunk to such small dimensions and is at such a depth that it is run through culverts in certain places. At the Sloane Square subway station it is carried in a steel pipe over the track.

Around Ludgate Circus, the cables again struck historical ground. There, another river—the Fleet—was encountered. This stream flows at such a depth that the cables could be laid above it. It is after this river that the world-famous Fleet Street is named.



Left—Cable-laying operation in which 120 men were employed. Right—Rollers used to facilitate pulling the cables through the chase.

Southwark Bridge while trench digging was in progress, showing four of the seven portable compressors with their paving-breaker gangs employed to expedite the removal of the hard concrete surface.

It is of interest to note that New Bridge Street, a section of which is paved with rubber instead of wooden blocks, runs parallel to and above this river. This is an experimental section, subject to quite heavy traffic. So far there is every indication that the rubber blocks will prove a success, but it is a question whether this method of paving will ever be adopted to any great extent. In this same section the cables run through the old Fleet prisons. A little farther away, under Upper Thames Street, the remains of an old Viking ship and portions of mosaic pavement were revealed in the course of excavating.

By means of this extensive system of underground cables, all the generating stations in the area are so linked that they can be cut in or out as required to take care of the load or to minimize trouble caused by breakdowns. The advantage of this was exemplified recently when the River Thames overflowed its banks and one of the generating stations was flooded. The station was cut right out of the circuit, and the load distributed between the other stations.

NEW FURNACES FOR THE BLACKSMITH SHOP

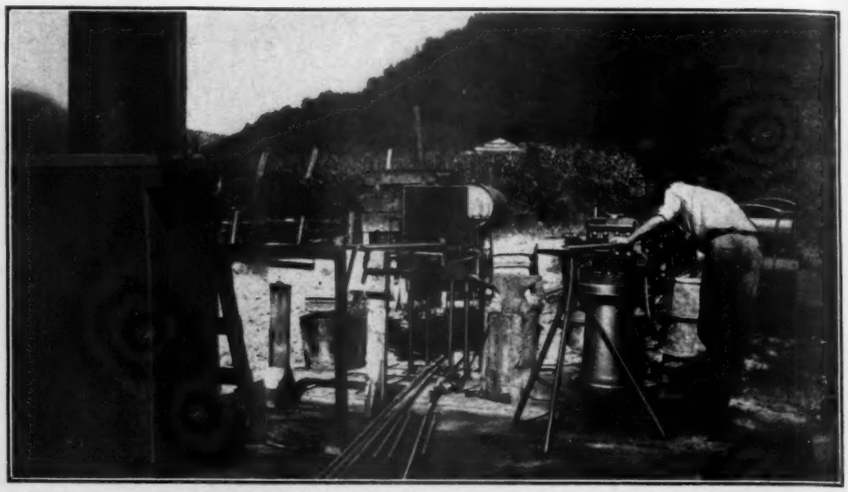
THE shops of the Ingersoll-Rand Company have turned out two new and improved types of furnaces for the heating of drill steels preparatory to their sharpening. These furnaces, known as the 6F and the No. 26, are essentially alike in structural details, differing only in size or in the amount of work they can do in a given period.

The 6F has been designed to meet the needs of small-scale mine and quarry operations or of the contractor who must move his equipment from place to place. This furnace is of light weight and easily portable—the three legs on which it is mounted being removable. It ha a capacity of about 85 drill steels per hour—in other words, is equal to the service demands of the company's No. 34 sharpener. The requirements of the larger No. 50 sharpener are well served by the No. 26 furnace, which is capable of handling in one hour approximately 175 drill steels. This unit is intended for permanent use in plants calling for a large output.

The outstanding features of the furnaces, as announced by the manufacturer, are: quietness of operation and economy in the consumption of compressed air and fuel, the latter being the direct result of more efficient combustion of the oil. This is effected by preheating all the air used, thus effectually removing from it any moisture and assuring complete atomization of the fuel oil. The saving in compressed air is brought about by means of an induction blower, which supplies 10 cubic feet of atmospheric air for every cubic foot of high-pressure air consumed.

Each furnace is equipped with a heat deflector and a flame blower for the comfort of the operator. The flame blower also makes it possible to obtain a very short heat on the steel. Suitable outlets—one in the case of the 6F and two in the No. 26—permit the escape of burned gases that would otherwise prove harmful to the steel. The fire box is lined with standard fire brick. This is an advantage, as it makes relining an easy job. Both furnaces can be modified to burn either manufactured or natural gas; and, if desired, the No. 26 can be fitted with an automatic temperature-control mechanism.

The No. 26 furnace is well suited for permanent use in shops where large quantities of drill steels must be sharpened daily.



This temporary blacksmith shop was able by the use of a 6F furnace and a No. 34 sharpener to take care of all the drill steels needed on a contract job.

LIGHTING INSTITUTE FOR NEW YORK

NEW York has a new attraction, and one that should interest everybody. It is the "City of Light"—a permanent institute for the advancement of the art of modern lighting that has been opened by the Westinghouse Lamp Company in the Grand Central Palace. In the Westinghouse Lighting Institute, as it is known, there is a street—Mazda Street—20 feet wide and 180 feet long; and fronting on this thoroughfare the welcome visitor will find a modern home, a bank, a theater, a gasoline filling station with accessory store and office, an industrial building, a department store, a florist shop, and two completely equipped electrical-supply stores, all lighted by the most approved methods. But this is just one aspect of the institute, which also includes displays of adequate lighting for shops, schoolrooms, railway cars, buses, airports, etc., etc. Besides, its facilities are such that the industrial engineer may go there with his plans of a manufacturing plant, for example; check his lighting specifications; and verify his calculations by ac ual measurements and observations. The architect will find there scaled models that will aid him in studying and visualizing the flood-lighting of prospective buildings and monuments. In short, everything pertaining to the art of illumination has been gathered under one roof for the primary purpose of helping the public to solve its varied and oftimes complex lighting problems.

In carrying a 20-foot, concrete-lined shaft through water-bearing gypsum down to a salt dome, lying at a depth of about 250 feet, the Texas Salt Company filled the fissures in the surrounding rock with both cement and asphalt. The asphalt grouting was used in the latter stages of the work; and pressures up to 2,000 pounds per square inch were required in thus sealing the seam between the gypsum rock and the top of the salt deposit.

Rapid Rock Crosscutting in a Gogebic Range Iron Mine

By N. E. NILSEN* and A. L. FOSS**

A HARD rock crosscut in the Eureka Mine, at Ramsey, Mich., was advanced 924 feet in 31 consecutive days! The Castile Mining Company considers this an accomplishment only because it was done in conjunction with the hoisting of 32,000 tons of iron ore by way of the same shaft through which the rock was hoisted. During those operations not one of the men employed at the mine suffered an injury.

An S-70 drifter viewed from the left of the column.

This work was done on the 24th level, which is 2,315 feet below the collar of the shaft. The shaft is in the footwall, with the formations inclined about 70° from the horizontal. This necessitates longer crosscuts on each new level as the shaft is deepened. The crosscut was driven on a line normal to the strike of the formations, and at a grade of one half of 1 per cent in favor of the loaded cars.

The rock through which this crosscut was driven consisted of 227 feet of hard unaltered granite, 408 feet of thin bedded quartz slate, 235 feet of hard massive quartzite, and 54 feet of iron formation and ore. While in granite, the crosscut was advanced an average of 27.3 feet per day; in quartz slate, 37.1 feet per day; and in quartzite and iron formation, part of which was timbered, 23.5 feet per day.

The best advance made in one day of 24 hours was 45 feet, or five 9-foot cuts; and the best week netted 267 feet of advance. This was done in the quartz slate. If enough of this rock had been available, and there had been no interruptions due to other activities in the mine, an average daily advance of 40 feet could easily have been maintained, resulting in a monthly advance of 1240 feet.

The crew at the heading under consideration consisted of 32 men, as follows: two bosses—one day shift and one night shift, 24 miners divided up into three shifts of eight men each, one electrician and a helper, two trackmen, and two ditchmen. When work on this program of intensive rock cutting was started, the breast of the crosscut was 275 feet in from the storage pocket at the shaft station.

The equipment used consisted of one modified Osana type scraper slide provided with a 10-hp., double-drum electric hoist with a rope speed of 200 feet per minute, six Ingersoll-Rand S-70 wet drifting machines, two single-jack drill posts, one drill truck, one equipment truck, two 4-ton electric locomotives, two 60-cubic-foot rocker dump cars, and one 20-inch Jeffrey universal blower fan with 400 feet of 12-inch galvanized piping. Compressed air at 90 pounds pressure was furnished; and this was conveyed down the shaft through an 8-inch column, and through a 4-inch pipe line on the level.

Drilling with an S-70 photographed at the right of the column.

The equipment truck, which is shown in one of the accompanying illustrations, carried air and water manifolds on its bottom deck. From these manifolds a 2-inch hose, extending rearward, connected with the 4-inch air pipe and a 1-inch hose with a 2-inch water line. Each drifter was at all times attached by suitable hose lengths to the air manifold on the equipment truck, which was fitted with line oilers—one for each connection. After a round had been drilled, the hose was detached from the machines and coiled up and hung on the sides of the equipment truck, as illustrated. The trucks were run on 50-pound rails laid in 15-foot lengths so as to facilitate handling and to permit the track to be laid closer to the breast.

The time schedule for a cycle at this heading was, for example, from 7 a.m. to 11.45 a.m., as follows:

	Hrs.	Min.
Rigging machines		25
Drilling 24 holes, average depth 8.4 ft.	1	40
Removing machines and blowing holes		15
Charging holes and blasting		25
Ventilating		15
Moving in loader		5
Mucking 26 cars	1	35
Removing loader and moving in equipment and drill truck		5
Total time to complete average cut	4	45

Four wet drifting machines, mounted on 4-inch by 8-foot vertical posts equipped with clamps and arms, were used at the heading throughout the work. Staging was provided for the men operating the upper machines. Two miners were assigned to each machine and were required to drill six holes. One and one-quarter inch, hollow, round steel was employed in lengths of 3, 5, 7, 9, and 11 feet. While mucking was in progress two miners oiled the machines and arranged the steels in the proper compartments on the drill truck. On its way to the work-

*Foreman Rock Development and Shaft Sinking.
**Chief Engineer.

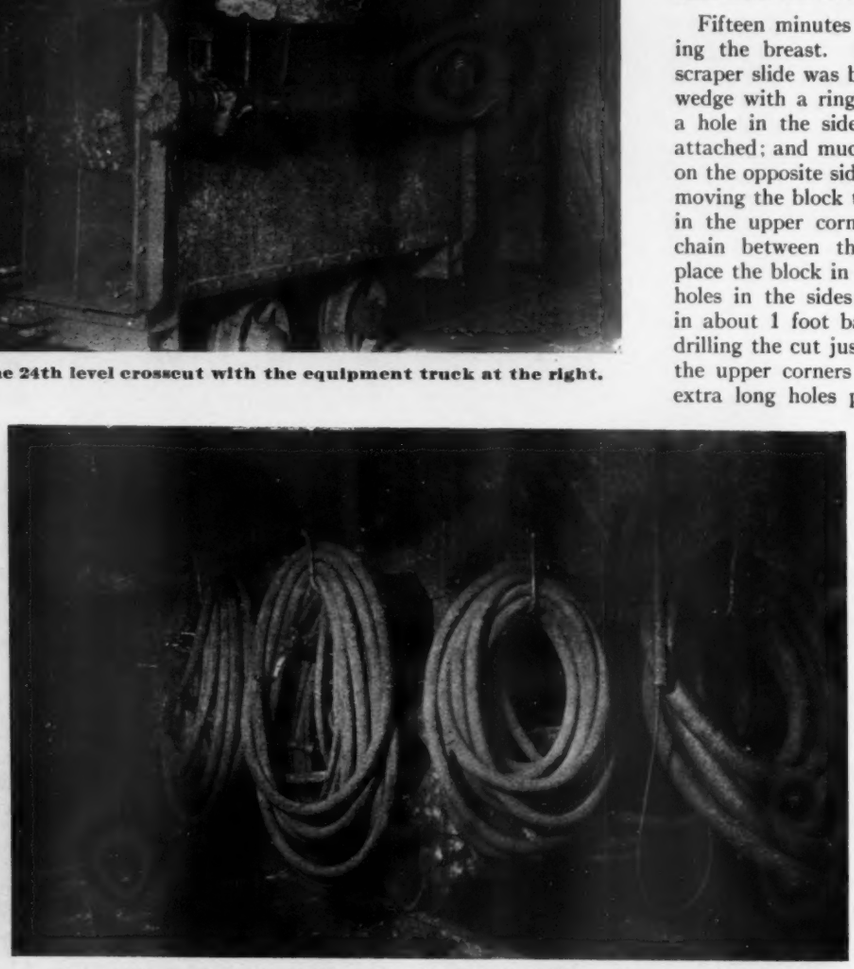
The drill truck in the 24th level crosscut with the equipment truck at the right.

ing face, the drill truck preceded the equipment truck—its two electric headlights serving to illuminate the breast. Wherever track and trolley wire were needed, they were installed while drilling was going on.

Before deciding on the use of vertical posts in preference to crossbars upon which to mount the machines, considerable discussion arose as to the safety of the different methods. It was finally concluded that two vertical posts, equipped with a safety collar to prevent the upper drills from falling the full length of the post, presented the safest and most efficient means of supporting the machines. The upper drills were at all times kept above the arms: the lower ones below the arms. To move the machines up or down, the arms were slid along the post.

A total of 24 holes was drilled for each cut; and the average time required to put in a round was 1 hour and 40 minutes. In granite the average drilling time was 8.1 inches per minute, in quartz slate it was 16 inches per minute. After drilling, the holes were blown out and all equipment transferred to the drill and the equipment trucks, which were then taken back to the shaft and prepared for the next cut. Immediately after blowing, the holes were charged. Five sticks of 1-inch, 80 per cent gelatin were placed in the bottom of each hole—the space remaining being filled with 1¼-inch, 60 per cent gelatin. All blasting was done by means of electricity from a 250-volt direct-current line. As soon as the holes were fired, a valve at the shaft was opened and the breast ventilated with compressed air discharged from a 2-inch nozzle. At the same time a 1-inch valve was opened, allowing water to enter the air line and thus to wet down the muck pile. In addition to this the fan was started. This sucked the smoke from a point a considerable distance back from the breast.

Fifteen minutes were allowed for ventilating the breast. Following this, while the scraper slide was being moved in, a split iron wedge with a ring attached was driven into a hole in the side of the crosscut; a block attached; and mucking begun. Another hole on the opposite side of the heading permitted moving the block to that side; and two holes in the upper corners of the breast, with a chain between them, made it possible to place the block in any desired position. The holes in the sides of the crosscut were put in about 1 foot back from the breast while drilling the cut just blasted, and the holes in the upper corners were the bottoms of two extra long holes previously driven into the cut and into each of which a short wooden plug had been inserted before blasting.



The equipment truck employed by the Castle Mining Company in driving the crosscut.

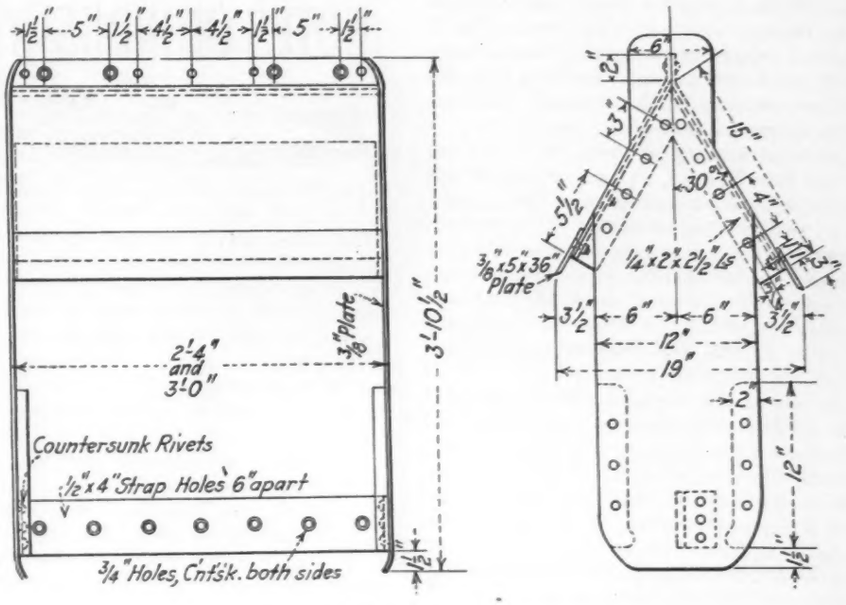
The outstanding feature of the mucking operation was the scraper slide, several of which have been built at the mine shops in recent years at a cost of not more than $1,500, including the hoist. This simple loading device was so efficient that a 60 cubic-foot car of rock, loaded in about 1¼ minutes, would be on its way to the shaft within five minutes after the miners had entered the place. The wide lip on the slide, with two 4-ton locomotives behind it, permitted the loader

Crew of miners who drove the 24th level crosscut in the Eureka Mine.

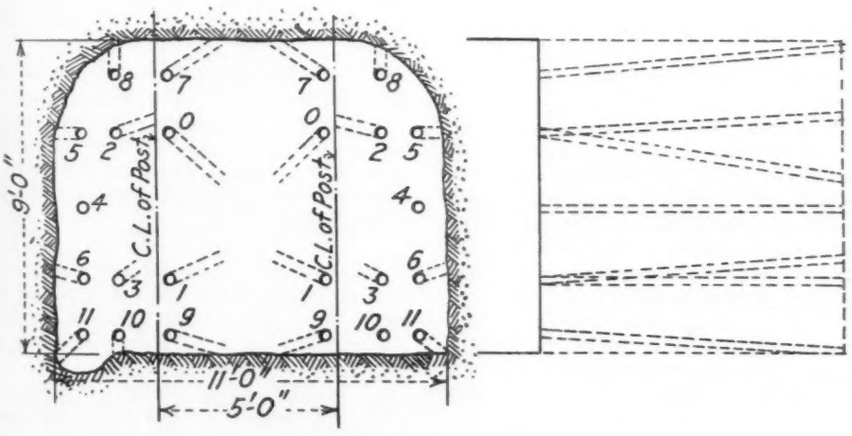
to be used like a snow plow. The scattered rock on the track was carried to the main muck pile. The slide was equipped with an arrowhead-type, bottomless, box scraper. One switch track was near the shaft; and when the crosscut had been advanced 500 feet it was slightly widened for a distance of 35 feet, thus providing another point where two trains could pass.

While mucking was in progress the crew of eight miners was engaged as follows: one man operating loader, two men tending scraper, two men rearranging drill and equipment trucks at the shaft, two men operating electric locomotives, and one man throwing switch. The two miners whose duty it was to look after the drill truck and to oil the drifters while the six others did the mucking were also required to extend the air and the water lines as the work progressed.

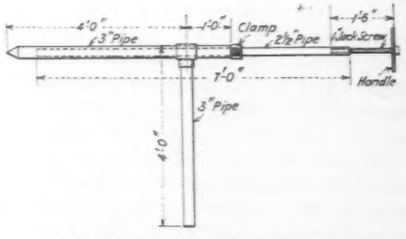
In addition to stringing trolley wire and lengthening the blasting line, the electrician and his helper had to install the fan piping, to oil the locomotives and the loader hoist, and to change the cables on the hoist whenever this was necessary. These men worked only on day shifts. When drilling, the bottom corner holes were inclined sufficiently to permit the ditch to be dug without additional blasting. The two ditchmen were required to clean up alongside the track and to dig the ditch while on an 8-hour night shift. The two trackmen were employed on day shifts.



Assembly of underground scraper.

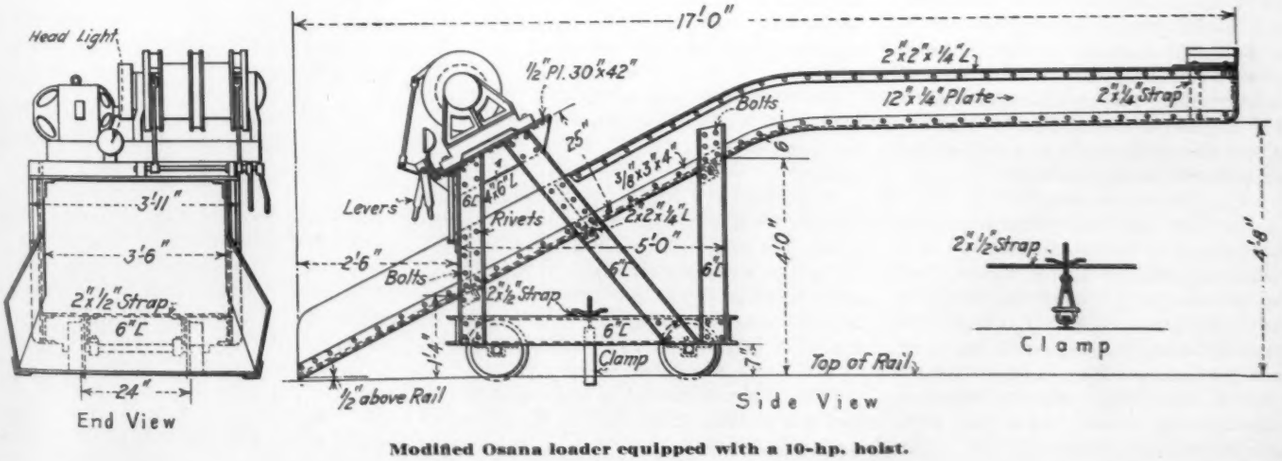


Drill round used in advancing the hard-rock crosscut.



Extension bar for drill staging.

From 7 a.m. to 7 p.m., the work was under the supervision of N. E. Nilsen, and under



Modified Osana loader equipped with a 10-hp. hoist.

Jacob Kettula from 7 p.m. to 7 a.m. All shifts were changed at the working places. The 24 miners in the crew were paid a contract price of $6 per foot of advance, resulting in a rate of approximately $1.03 per hour. All other labor received a daily rate of pay.

After the heading had been driven 712 feet in the first 22 days, an area of faulted and dangerous ground was struck. This necessitated the installing of timber and forepoling. Progress was therefore considerably retarded; but no chances were taken for the sake of speed. However, the heading was advanced a total distance of 924 feet in 31 days in spite of the difficulties encountered towards the end of the work.

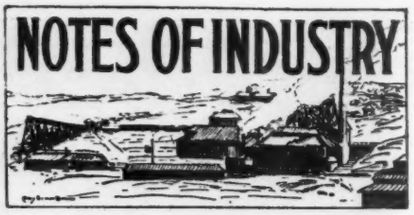
To quote our superintendent, John M. Price: "The performance in this place was obtained by the operation of four dominating factors. First, supervision; second, organization of the crews so that there was no lost time and no overworking of the men; third, proper equipment; and last, but not least, active coöperation of all departments and the sustained enthusiasm of the entire organization."

EXTRACTING VALUES FROM PINE STUMPS

A large and profitable business has been built up on pine stumps—to be exact, on the values in pine stumps, such as turpentine, rosin, and pine oil. The nucleus of the business is the plant of the Newport Company, at Pensacola, Fla. This plant covers 40 acres, but its operations extend 250 miles east, north, and west into the cut-over lands of western Florida and southern Alabama. From this area, the company draws daily about ten carloads or from 250 to 300 tons of raw material made up of pine stumps, knots, and branches left in or on the ground by the lumberman.

The gathering of this erstwhile waste material requires a corps of field experts, and they go from place to place and teach the landowners or contractors how best to go about the work. As the market value of the stumps usually is sufficient to defray the expenses of clearing cut-over lands, thousands of acres within the operating radius that might otherwise still be lying unproductive are now under cultivation. The magnitude of the operations can be better appreciated when it is known that the bill for the raw material has come to about $350,000 annually. The Newport Company is producing daily more than 1,000 gallons of pine oil, 1,600 gallons of turpentine, and 175 barrels of rosin. And it might be added that the waste product or chip is used for fuel under the plant's boilers.

Canada's Pulp and Paper Research Institute has opened its doors and promises to be of outstanding value in solving the problems relating to one of her most important industries. The new institute is located in Montreal, and owes its being to the combined efforts of the Canadian Pulp & Paper Association, McGill University, and the Dominion Government. It is said to be the finest laboratory of its kind in the world.



The commission which was created by the Spanish Government for the purpose of studying the geological and oceanographical conditions in connection with the projected Strait of Gibraltar Tunnel is continuing its work during 1929. It has so far been determined that the passageway cannot be driven under the strait where it is narrowest, because the rock formation along that line is pervious to water. Nearer the Atlantic coast, however, the conditions are believed to be favorable for tunneling; and soundings are now being taken to ascertain the depths between Tarifa, Spain, and a point directly across on the African shore, which may be the route of the tunnel.

The latest estimate gives the Dominion of Canada a population of 9,685,000, an increase of nearly 900,000 inhabitants since 1921.

Work has been begun on the Los Angeles Flood Control Project which involves the construction of seven dams at an expenditure estimated between $30,000,000 and $35,000,000. The San Gabriel Dam, the first to be taken in hand, will be of the arched gravity type. It will be 2,300 feet across at the crest and 660 feet at the base, where it will be 412 feet wide. The width at the crest will be 20 feet. The foundation for this structure, which will be larger than the six other dams combined, will involve the removal of more than 1,200,000 cubic yards of material.

The subway system of Madrid, Spain, now has a length of six miles, an extension of 1.15 miles having been opened to traffic recently.

Finely divided lime and steam injected into boiler flues should, so it has been suggested, prevent the discharge of sulphurous fumes from the stacks of power houses. Thus would be formed calcium sulphite and sulphate, solids that could easily be arrested and recovered in suitable dust collectors.

Between 1920 and 1927, the per capita consumption of electric power in Canada has increased 46 per cent.

A matter of 2,300,000 radio sets, taking current from house circuits instead of batteries, was sold in the United States in 1928. These sets have placed a load of 200,000 hp. upon electric light and power companies, or a block of energy sufficient to supply all the needs of a community of 500,000 people.

Back River, Montreal, is to be spanned by two new bridges to be built at an estimated cost of $2,300,000.

America's first annual Metals Congress is to be held in Cleveland, Ohio, September 9 to 13, in conjunction with the eleventh annual convention and exposition of the American Society for Steel Treating, of which the congress is an outgrowth. It should also be mentioned that, coincident with these events, will be the fall meetings of the Metals Division and of the Iron and Steel Division of the American Institute of Mining and Metallurgical Engineers, of the Iron and Steel Division of the American Society of Mechanical Engineers, and of the American Welding Society—making Cleveland, for the time being, the center of interest of the metals industries.

What is reported to be the largest deposit of onyx-marble in the United States, if not on the continent, was discovered not long ago in the Black Hills, within a few miles of Custer, S. Dak., where a quarry has been opened. Explorations have proved the vein to be 300 feet wide and 1,500 feet long. Onyx is not only one of the hardest but also one of the most beautiful and high priced of all the marbles.

An hangar so large that its floor space will accommodate six miles of freight cars, or that will house side by side and with room to spare the airplane carriers *Saratoga* and *Lexington*, is soon to rise within the confines of the municipal airport of Akron, Ohio. This immense structure will be 1,200 feet long, 360 feet wide, and 200 feet high, and will be in the form of an elongated archway without supporting pillars. In this hangar is to be built the first of the two great dirigibles recently authorized by Congress for the United States Navy.

In its report of our national wealth, the Federal Trade Commission has placed the copper ore reserves of the United States at 1,588,000,000 tons. These reserves are owned by 138 companies.

The central precipitation plant at Copperton of the Utah Copper Company is producing about 100,000 pounds of copper daily, according to the management, from the huge dumps of tailings that have risen in the course of years. This is in addition to the plant's regular output. The dumps are estimated to contain at least 1,000,000,000 tons of waste and oxidized ore.

To give Bucharest an outlet to the Danube, the Rumanian Government has undertaken the building of a 52-mile canal.

A simplified method of laying drainage tiles in irrigated lands is reported in use in California. The ground in which they are to be placed is first gone over with a mole drainer drawn by a tractor, which then draws a string of tiles into position. The tiles are threaded on a manila rope, at the end of which is put a plate to bear against the last tile. With a 30-hp. tractor, it is possible to pull a string 200 feet long in one operation.

Compressed Air Magazine

—Founded 1896—

Devoted to the mechanical arts in general, especially to all useful applications of compressed air and to everything pneumatic.

Business and Editorial Offices:
Bowling Green Building, No. 11 Broadway, New York City
Tel. Bowling Green, 8430

Publication Office: Phillipsburg, New Jersey

TERMS OF SUBSCRIPTION

$3 a year, U. S. A., American possessions and Mexico; all other countries $3.50 a year, postage prepaid. Single copies, 35 cents. Back issues more than six months old, 75 cents each.

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EDITORIALS

FUNDS NEEDED TO REBUILD "OLD IRONSIDES"

THREE years ago we called attention to the generous sum of $192,000 contributed by the school children of the United States for the rehabilitation of the frigate *U. S. S. Constitution*, popularly known as the *Old Ironsides* because of the almost miraculous way in which that gallant ship withstood the fire of her enemies on numerous occasions. The rebuilding of the craft has gone forward in the interval at the Boston Navy Yard, and this commendable work has been carried onward to 63 per cent of completion. The patriotic committee that has this undertaking in hand reports that $250,000 is still needed to restore the vessel to her pristine glory as an example of our naval might in the days when the very integrity of our national life was in peril. It is earnestly hoped that the people of this country will subscribe promptly this really modest sum for the perpetuation of a nautical monument that can never be anything but an inspiration and an appeal to our finer impulses.

As is in the nature of such structures, the *Old Ironsides* was repaired frequently, and on more than one occasion virtually rebuilt as her sturdy timbers succumbed to the insidious attacks of time and the elements. But that work always faithfully preserved the distinctive characteristics which marked the *U. S. S. Constitution* when she was launched at Boston in 1797. The rehabilitation now in hand holds similarly to those splendid lines that enabled the ship to perform so gloriously whenever put to the test of wind and wave and battle.

The *Old Ironsides*, when rebuilt, will symbolize our national capacity to win against heavy odds, and it will also serve as a milestone to mark how far we have progressed in the past 130 years in all the arts that contribute to the get-up of a fighting ship.

HOW BIG ALASKA

IT may not convey much to most of us to be told that Alaska, including the Aleutian Islands, has an area of nearly 591,000 square miles; but the bigness of that territory was made graphically plain to us in our school days by laying an outline of Alaska on the familiar map of the United States. Even so, the magnitude of Alaska was not then in reality brought home to us, except in a comparative topographical sense that left much to the imagination. But there is one branch of the Government organization that does, indeed, comprehend the greatness of Alaska and the magnificent proportions of many of its outstanding features—we refer to the United States Geological Survey. After 62 years of ownership, we have yet to explore numerous far-flung sections of that northwest part of the continent; and it is the function of the Survey to do this work—a task that is often an extremely toilsome one and bristling frequently with adventure and hazards.

The mapping of Alaska's tremendous wilderness has been underway since 1898; and, while progress has been made year by year, still the topographical exploration of the region is far from completed. The Survey has recently published the result of a season's work in 1926 that covered 700 square miles of hitherto unexplored territory, 350 square miles of territory previously mapped and reexplored, and the remapping and correcting of the topographic work relating to that section. An idea of what this involved has been outlined by a memorandum issued not long ago by the Survey. The particulars are both interesting and suggestively picturesque.

As explained: In a new, unexplored country, where streams are too swift for boating and the only trails are those of wild animals, the surveyor must still use primitive methods of transport such as the slow but sure pack horse and the boat dragged by hand through water too swift for even a modern power boat. Both of these aids were used in extending topographic and geologic surveys into the upper portion of the basin of the Skwentna River. The Skwentna is a large western tributary of the Susitna River, and drains a hitherto unexplored area in the heart of the Alaska Range south and east of Rainy Pass.

The party—consisting of four camp hands in addition to the topographer and the geologist, and of sixteen pack horses and two tons of supplies and equipment—was divided into two parts. The pack train, with four men, was carried by launch and scow from Anchorage, on the Alaska Railroad, to the west shore of Cook Inlet, to travel over a trailless country to the upper basin of the Skwentna. The other men, with most of the supplies, were provided with a shallow-draft boat and outboard motor and proceeded up the Susitna, Yentna, and Skwentna rivers, traveling with the aid of the motor, where that was possible, and wading and dragging the boat by hand through the miles of rapids. At the point where even this kind of boating was no longer feasible the two parties joined and traveled thence southward into the very heart of the great mountain range.

No human being was seen during a period of over two months; and even the few signs of native camps indicated that they had not been occupied for twenty or thirty years. In September, when the approach of winter put an end to the work, the expedition retraced its own route to the coast. This exploit is fairly typical of what the Survey is doing year after year, without any parade, in revealing and in mapping unfamiliar and hitherto unknown parts of our national possessions. The men that do this must be red-blooded and possessed of the spirit of the pioneer.

PERSUASIVENESS OF SEX IN SALESMANSHIP

FROM whom would you rather buy? Is it all the same to you whether you deal with a salesman or a saleswoman? These may seem unimportant questions to many of our readers, but, even so, the fact remains that sex apparently does play a not inconsiderable part in persuading a purchaser, especially when hesitating about making an investment. Proof of this is contained in a recent issue of *Domestic Commerce*.

According to that Government publication, a study was conducted by Tufts College to ascertain the preference of customers with reference to the sex of the salespeople who serve them. It seems that no objection to buy from salespeople of the opposite sex was reported by 81 per cent of the women customers surveyed nor by 69 per cent of the men questioned. So far, so good; but some very suggestive admissions were made when the groups queried told about purchases of things they really did not want. Here is where the opposite sex seems to have got in its good work in overcoming opposition on the part of the buyers.

Of the women customers, fully 35.4 per cent were induced by capable salesmen to buy against their better judgment; and 44.2 per cent of the men fell for the persuasive wiles of the saleswomen—leaving the stores with things that were not those desired by them when they entered the shops. At first blush, one might be justified in concluding that men are relatively easier to influence in such circumstances; and the survey also disclosed that the older women and the younger men were generally those most responsive to the sales talk of the opposite sex. Perhaps additional research will bring to light how far the age or youth of the successful seller added to his or her effectiveness; and further inquiry may disclose the part played by good looks and grace of manner.

With the data already gathered, and when additional facts and figures become available, possibly sales managers may be able to so

organize their forces and to so direct their employment as to meet the requirements of any selling situation, giving due consideration to the mental processes of the man or the woman purchaser. In the end, it will in all likelihood become evident that successful selling in the long run is not dependent upon the appeal of sex but upon a shrewd exercise of human understanding, a full knowledge of the commodities handled, and, lastly, upon a display of tact and decent manners.

NEW CONCEPT OF THE EARTH'S CORE

THE core of this globe on which we live and move and have our being is a glasslike molten mass measuring half the diameter of the earth. Not only that, but this intensely hot and fluid composition is subjected to the stupendous pressure of 50,000,000 pounds to the square inch and has a computed temperature of more than 90,000° F. Such is the impressive and revolutionary concept of the inner structure of the earth as pictured by no less an authority than Dr. REGINALD A. DALY, Professor of Geology at Harvard University. The coming summer may be a relatively cool one; but, if Doctor DALY be correct in his assumption, we can comfort ourselves with the thought that Mother Earth has, at least, an incandescent heart.

Some one may be inclined to ask, "How is this vast globular mass of molten glass kept in place, especially if we accept the theory entertained by some scientists that the hard crust of our globe is really only a thin shell of solidified matter?" Doctor DALY confutes this idea, and he has gone to some pains to tell us just what lies between the white-hot core and the surface upon which we dwell.

As he explains it, the core is enveloped by a tremendously thick shell composed of metallic iron such as comes to us from space in the form of meteoric bodies. Then follow encasing zones of basalt and granite which, in their turn, are cloaked by a terrestrial crust that has a thickness of 30 miles. Because the central fluid half of the earth's interior has to support the encompassing more or less plastic rock formations, any disturbances of the stability of the core may lead to outer deformations producing earthquakes and even volcanoes and mountain ranges.

In his paper read a short while back before the Seismological Society of America, Doctor DALY is reported by the *New York Times* to have said: "Just as the chemist is studying the anatomy of the atom, the astronomer the structure of the star by the study of light and heat waves, just as the depth of the ocean can now be tested by measuring the echo of sound waves from the bottom of the sea, so the geologist can now infer something of the structure of the earth by analyzing the long waves set in motion by the mighty hammer of an earthquake." Doctor DALY may be only partway right, and he may be even more wrong than right; but his contribution to this absorbing subject will have its value nevertheless, and there is no denying the fascination of the spectacular picture he draws for us.

OUR FEDERAL LANDS, by Robert Sterling Yard. An illustrated volume of 360 pages, published by Charles Scribner's Sons, New York City. Price, $5.00.

THE author, who is executive secretary of the National Parks Association, gives us in this book information garnered by him in the course of the last twelve years; and his desire is to make readily accessible to the people at large a fuller grasp of what their national estate in the Federal lands really comprehends in the way of scenic beauty and physical grandeur of a rare and wide sort. He has unrolled in his story a panorama of wonders; and none can read without wishing to see what the author has seen. It is a heritage that will inevitably become more precious as time goes on and the dwellers of our populous communities long for the wide spaces and for nature in her primeval splendor.

INFLUENCING MEN IN BUSINESS, by Walter Dill Scott, Ph.D., and revised and enlarged by Delton T. Howard, Ph.D. An illustrated book of 172 pages, published by The Ronald Press Company, New York City. Price, $2.50.

IN varying degrees and with more or less significance, everyone in business or professional life has to deal with other people and to win them or to persuade them for a given purpose. Broadly stated, the people that are most successful in this appeal to others either wittingly or unwittingly utilize definite principles of psychology. When first published about eighteen years ago, the object of this book was to explain these psychological principles and to apply them particularly in selling and in advertising—the effort being to present the subject in a way that well-nigh any one could understand and utilize. Because much has been learned during the intervening years, the book has been revised so as to bring it up to date and to make it even more valuable than it was originally. Doctor Howard has performed this service well.

WAR HISTORY OF AMERICAN RAILROADS, by Walker D. Hines. A book of 336 pages, published by the Yale University Press, New Haven, Conn., for the Carnegie Endowment for International Peace. Price, $3.75.

THE war history of American railroads is a story of Government control exercised over one of the many departments of the nation's industrial life during the recent period of worldwide conflict. The general public recalls that period of control with more or less exasperation, remembering that private convenience counted relatively little in the much more vital scheme of utilizing the country's resources in combating a common enemy. The situation was an abnormal one, and the merits or demerits of Government control are not to be considered in evaluating the operation of the railroads a that time. As General Hines well expresses it: "In the interest of clear thinking, it is important to realize that Federal control does not constitute a sound argument either for or against permanent peacetime Government ownership and operation. What Federal control does primarily is to illustrate in a particularly concrete and visible way the disrupting and destructive influences of war, strictly similar in effect to what would have been exemplified by private wartime control, though differing in various details." General Hines' book is a notable contribution to the exposition of an economic study of prime importance and significance.

AN INTRODUCTION TO CRYSTAL ANALYSIS, by Sir William Bragg. An illustrated work of 168 pages, published by D. Van Nostrand Company, Inc., New York City. Price, $4.25

THE book has to do with the development of X-rays as a means of studying the structure of matter. The important methods of crystal analysis are also covered, and all stages of crystal analysis are developed. A final chapter is devoted to an investigation of the structure of metals and alloys by X-ray methods. In brief, this work reveals how much has been done in latter years in utilizing the X-ray for what might be termed practical purposes.

"Calyx" Drills is the title of an interesting and informative booklet recently issued by the Ingersoll-Rand Company, 11 Broadway, New York City. This form of drill can now be had in various sizes capable of cutting cores ranging from 2½ inches to 36 inches in diameter. The drill can, therefore, meet satisfactorily many conditions and requirements. While the principal fields of usefulness are in mining, in quarrying, in oil- and water-well work, and in road-pavement testing, still these drills can be adapted for numerous other services. The booklet should be in the hands of everyone engaged or about to engage in core drilling; and a copy of it can be had by any responsible person free upon request.

Engineering Achievements, 1928, issued by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. This pamphlet describes and illustrates some of the outstanding ways in which that company has contributed to engineering advance.

Mine and Quarry Book is the title of a bulletin issued by Edgar Allen & Company, Ltd., Sheffield, England. This pamphlet contains much information of value to the quarryman, and can be had upon request.

Pile-Driving Machinery and Foundation Equipment is the title of a comprehensive booklet issued by the Union Iron Works, Inc., Hoboken, N. J. It contains much helpful information.

Quarry Car Practice is the title of a bulletin issued by the Easton Car & Construction Company, Easton, Pa. It shows some of the many ways in which that company's cars are used.